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Abstract

Effectively involving low-SES parents in human capital development
Evidence from a field experiment*

In this paper we analyze the effect of involving parents in human capital investment. We study the effect of a parental app on student effort in a digital homework practice tool, and its effect on subsequent human capital development. The randomized field experiment includes more than 2000 7-9 grade students of 2 schools and we specifically focus on different socio-economic status (SES) groups. The results indicate that parental involvement via an app positively affects effort and human capital development of 7th and 8th grade students, but not of 9th grade students. The positive effects are mainly driven by low-SES students and are larger for males.

JEL classification: I20, I21, I24, C93
Keywords: parental involvement, randomized field experiment, socio-economic status (SES), student effort, human capital development, secondary education

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1. Introduction

In traditional human capital models, ability and effort are seen as the basic determinants of the learning outcome and most studies analyse the investment decision regarding effort. In recent years, economists have increasingly paid attention to the role of incentives to foster student effort, mostly with the framework of behavioural economics in mind (for an overview, see Lavecchia et al., 2016). Most of ability and effort that contribute to human capital development take place in traditional education settings, but at home, parents also contribute to the human capital of their children (Cunha & Heckman, 2007; Heckman & Mosso, 2014). This happens through the relation between family background and educational outcomes (Sirin, 2005), but also via specific parental involvement, with the aim to increase (additional) effort towards human capital development. However, the effective time investment of parents regarding their children's human capital development varies strongly, not least with the socio-economic status (SES) of the parents and their educational level (Green et al., 2007), and it is unclear how to increase effective time investment.

This paper uses a randomized field experiment to study 1) whether a parental app can increase parental involvement in effort and human capital investment of students in lower secondary school, and 2) the extent to which the effect differs by SES and gender. We conducted an experiment in two schools in the Netherlands, involving *all* students in grades 7-9 of these schools. Parents were randomly selected to be invited to use a free app to be informed about their children's effort and cognitive development in mathematics and language in a digital homework tool. The app provided detailed information on whether their child put in effort (practiced with the tool), on math and language performance, and on effort and performance of classmates of their child. To gather information on student effort and performance in the digital tool, student background, earlier student performance and on

potential mechanisms, we use information from the digital practice tool, the school student administration system and from parent and student questionnaires.

From the literature it is unclear whether parental involvement can be manipulated to positively contribute to student effort and subsequent human capital development. Although there are many studies on effects of parental involvement, most studies use correlational analyses, fixed effects, or structural approaches (e.g. Todd and Wolpin, 2008; Cunha & Heckman, 2008; Aizer, 2004; Welsch & Zimmer, 2008), and there is a lack of experimental evidence on this (Avvisati et al., 2010). Only a few studies exist on the causal effect of parental involvement on effort and human capital development (Bergman, 2019; Mayer et al., 2018; Balli et al., 1998; Avvisati et al., 2014). Given the increasing use of technology, both at home and in schools, the question is whether technology can be used to effectively involve parents, including the low-parents. However, the existing studies mostly include non-digital interventions (Bergman (2019) and Mayer et al., (2018) being the exception) and are only able to show the effect on student behavior and effort but not on human capital development (again, Bergman (2019) being the exception).

This paper contributes to the literature in a number of ways: First of all, this individually randomized study with more than 2000 students has sufficient power to show an effect of the intervention if present. Although the previous experimental studies did find effects, they were a priori underpowered. Second, this study evaluates an intervention that does not cost a lot of effort or money from the school or the parents. The previous experimental studies mentioned above were cheap in financial costs yet were costly with respect to effort required from the school/teachers and/or the parents. Third, we do not only study the effect of parental involvement on student effort, but also on human capital development in mathematics and languages, whereas previous students did not study or were not able to show effects on student performance. Lastly, the study includes all students, not only socially deprived students, which

makes the external validity higher than some of the previously conducted studies that only focused on socially deprived neighborhoods and parents. However, similar to the previous studies, we *are* interested in the differences between different SES groups.

The analyses reveal a significant positive effect for 8th grade students from the provision of free access to a smartphone app, which allows parents to follow-up on their children's effort and mathematics and language performance. We find negative effects on effort of 9th grade students. Subgroup analyses show that the positive and significant effects that are found (both on effort and on human capital development) are more prevalent for male students and are mostly driven by the low-SES students, whereas the negative effect of the parental app on student effort in grade 9 is also due to the high-SES students. Further analyses of potential mechanisms reveal that there seems to be a better match in the needs and offers of parental involvement by children and parents in 7th and 8th grade, and not so much in 9th grade. Furthermore, it seems that the ranking of the child in the family can explain some of the findings, as it does seem that if low-SES parents can be persuaded to be more involved in their children school work, they will do so for all their children equally, whereas parents in the other two SES groups are significantly less likely to be involved through an app for their younger children than for the oldest child. We do not find any evidence for a substitution effect for high-SES parents and students.

In the following paragraphs, we continue with a section on background and experimental design, followed by descriptive statistics and the methodology used. The results section first focuses on the effect of the app on student effort, thereby analyzing all students as well as elaborating on the socio-economic heterogeneity of the effect. This is followed by the results on human capital development (math and language performance) and various robustness checks. Lastly, we discuss the descriptive outcomes of both a parent and a student

questionnaire, which we link to the causal effects that we find, and we analyze potential mechanisms of the effect we find for low-SES students. We finalize the paper with a discussion.

2. Background, Research Context and Experimental Design

a. The schools under study

The two schools under study are - to Dutch standards – both mid-sized schools for secondary education (junior high and high school), located in the Southern part of the Netherlands, in the province of Limburg. Both schools offer secondary education in all tracks[1] and are tracking students from 7th grade on in several prevocational, general and pre-university tracks. The two schools have 2169 and 2522 students respectively (national average M = 1514, SD = 1177), 182 and 212 FTE teachers employed (national average M= 124, SD = 104), a graduation percentage of 96 and 95 percent (national average M= 92, SD = 4), an average national exam grade of 6.8 and 6.6 (on a scale from 1 to 10) (national average M = 6.4, SD = 0.2) and a share of students that have to retain a grade of 3 and 6 percent (national average M =6 percent, SD = 7).[2] Hence, the students of both schools are doing relatively well in terms of performance.

b. The broader research context

The randomized field experiment with the parental app was part of a wider research project that studied the effect of parental involvement on whether students would do their homework in a digital practice tool[3] and the effect of (practicing with) this digital homework tool on math and language performance of secondary students (a so-called ITS, intelligent tutoring system, see Bartelet et al. (2016), Haelermans and Ghysels (2017) and Ghysels and Haelermans (2018)

[1] Dutch secondary education has a tracking system from 7th grade on, with 3 different tracks: prevocational education (which consists of 4 sub tracks where level 1 is the lowest (mainly practical) track and level 4 the highest (mainly theoretical) track), general higher education and pre-university education.

2 The data are from October 2014, and are obtained from the governmental website containing the Dutch open education data (https://www.duo.nl/open_onderwijsdata/databestanden/vo/).

[3] See Online Appendix 2 for more information on the digital homework tool Mousework

for literature overviews and effects from earlier studies on this ITS). This research project was set out in two secondary schools in the Netherlands, and included all students in grade 7, 8 and 9, with a total of 2450 students participating in the study[4]. All students were supposed to practice 30 minutes per week for math and 30 minutes per week for language with the digital homework tool, during one school year. For each class a specific teacher was assigned to keep an eye on this and motivate students to practice. The students' performance on math and language was measured using digital standardized validated tests (see Section 3d*ii*). They wrote a pretest in September 2014, a first posttest in January/February 2015 and a second posttest in June 2015.

The relevant policy context of the experiment are new learning goals introduced for the national graduation exam in order to tackle a lack of basic language and math skills in the Dutch population that was qualified as "problematic" (Commissie Meijerink, 2008). Van Groenestijn (2007) reported earlier on substantial deficiencies. Depending on the secondary education track, 10% to 50% of first-year secondary students (7th grade) have mathematics skills equivalent to or lower than the skills they are expected to possess at the end of Grade 4. Schools reacted to the new learning goals in a variety of ways, from highly targeted remedial teaching to extended teaching for all students. The schools under study decided to offer a digital homework tool for individual use at home, without specific action at school apart from communication about the new graduation exam and follow-up of the practicing behavior by (some) teachers. It was assumed that the didactical efficacy of the ITS, combined with the existing teaching of math and language, would suffice to reach the required skill levels. Moreover, the introduction of the new exam requirements was hotly debated in Dutch media,

4 Technically, this project was set out in three secondary schools. However, the third school was a lot smaller, only participated for Dutch language, and used a different student registration system, to which parents could *not* logon, contrary to the other two schools, implying a completely different control condition for the effect of parental involvement. Therefore, this third school was not comparable (although results were fairly similar when the school was included in the main analysis) and was therefore left out of the analysis for the paper at hand and is consequently not further mentioned in this paper.

which is likely to have motivated parents to take an interest in the topic and help motivate their children to use the tool effectively.

c. The randomized experiment with the parental app

Previous studies have shown that students are not necessarily intrinsically motivated to do their homework in the digital practice tool, but students tend to use it more frequently when they are motivated to do so by for example their teacher (Haelermans & Ghysels, 2017). Therefore, the above described research project also included a parental aspect, examining whether parental involvement via an app would increase the amount of homework time students spent in the digital practice tool, and whether that in turn would lead to higher performance. The app was free of charge and available for both IOS and Android. The app allowed parents to log on to the Mousework system with their child's login number (student number). Once logged in, they could see the number of minutes practiced per week, separately for math and language, in the current as well as in preceding weeks. They could also see a comparison between their child's practice behavior and the practice behavior of its classmates, and compare their child with him/herself over time. Furthermore, there were performance data available, again over time and compared with classmates, and a suggestion which aspects of math and language would still need to be improved. Parents could choose to look at the raw numbers, or read a short written story that was automatically generated based on these numbers. The app enabled parents to add multiple children to the app and follow all of them simultaneously.

The app registered the child's login number every time the parent logs in. Unfortunately, it was not possible to register what exactly the parent was looking at when logged in to the app. In case of multiple children, the app does register for which child the parent has logged in though.

As part of the experiment, only about half of the parents could actually log in to the app (as will be further explained in the identification strategy in Section 4a), whereas the other half did not have access (created as such that this was technically impossible). However, *all* parents where asked and motivated to download the app, for two reasons: 1) The app was not new and had already been promoted by the representative of the digital practice homework tool in the the year prior to the intervention. We wanted to prevent building on a previously existing potential information and selectivity problem (potentially leading to inequality in information, favouring student from better informed and more active parents, which are often the higher educated parents), and therefore chose to actively inform all parents about the app; 2) Given this first aspect, we wanted to get information on the willingness of parents of using the app at all, or rather, to get an idea about the selectivity of parental involvement using a digital tool such as this. Only after downloading and logging in (or trying to) parents would find out whether they were assigned to the treatment or control group. Parents who belonged to the control group would, upon trying to log on, get a message reminding them of the experiment and clarifying that they would be able to login to the app after January 2015 (i.e. for the second part of the schoolyear).

Parents were informed about the experiment in two ways. First of all, they received a letter via their child's school, explaining the study in plain, non-technical, language, and asking for their cooperation. Furthermore, the parents were informed at the yearly parental information meeting at the start of the school year. In the one of the two schools, the researchers presented the research and informed and motivated the parents to participate, whereas at the other school this was done by the personal mentor of each class (requested by the school, for organizational reasons). Although parents could use the app as often as they pleased, in both the letter and at this meeting, they were advised and asked to use it at least once a week.

Figure 1 shows the timeline of the parental app experiment. The experiment lasted for 14 to 18 weeks, depending on when exactly the students wrote the pre and posttest (as all students and classes in grades 7-9 were tested, and the number of computer rooms at the schools were limited, testing took a couple of weeks). In summer, students and teachers were assigned to classes. In week 32 randomization took place by the researchers, and in week 35 the school year started. Shortly thereafter, students wrote the pretest. At the same time, the schools organized parent information nights, in which the experiment was explained. Note that parents also received a letter which explained the experiment in the week before the information nights. At the end of the experiment, in week 48, we handed out parental questionnaires, to get additional background information from the parents, and the questionnaires were collected right after the Christmas break. A student questionnaire was filled out in the week after the posttest was written (it was logistically impossible to do this at the same time). With this, the experiment of the first semester, i.e. the parental app experiment, and the first part of the larger experiment came to an end.

[Figure 1 around here]

3. Data

a. Data sources

Data are collected, and merged at the student level, from multiple sources: 1) Statistics Netherlands, from which we collect family and parental background information, 2) the administrative system of the schools, from which we collect student background data and data on the parental use of the student administrative system and, 3) the Back office system of the digital homework tool Mousework, from which we collect practice data and student

performance on the tests, and 4) student and parental questionnaires, from which we collect additional information on both children's and parents' attitudes towards parental involvement.

b. Microdata from Statistics Netherlands

The microdata from Statistics Netherlands is register data, containing demographic, labor market (when available through tax administration data) and educational data, among others, on all residents of the Netherlands. From this source, we have access to job market information (whether someone has a job, income[5], fte and the financial situation of the household (from now on referred to as household funds), data on the educational level of parents and family information, such as the number of people in the household, the number of parents born abroad, the immigrant generation of the child, the birth year of both parents, and the Socio-Economic Status (SES) of the family. The Socio-Economic Status of the family is calculated based on the Dutch tax authorities' regular practice to define the total taxable household income, which sums the income of father and mother plus 4% of the household funds. By regular practice of the OECD equivalence scales (OECD), we divide this number by the square root of the number of people in the household to obtain an equivalized income (income adjusted to the composition of the household). This procedure eventually gives us an indication of SES. If parents are not registered to the same household number, we only include mothers' information, (because a large share of children lives with their mother when the parents are separated), unless it is explicitly registered that the child lives in the same household as the father.

c. The administrative system of the schools

i. Student background data

[5] This measure includes income from all sources, so not only from labor, but also from social security, among others.

From the school administrative system, we have information on the students' grade level, the average score on the primary school ability test, gender, age and situation at home (both parents living at home vs. parents having divorced or one parent being deceased). We merged these school data to a neighborhood SES indicator that is constructed by the Netherlands Institute for Social Research (SCP) at the 4-digit postal code level, roughly corresponding to a district. This variable is constructed by the Netherlands Institute for Social Research (SCP) and is constructed at the 4-digit postal code level, roughly corresponding to a district.

The experiment includes all students in grades 7-9 of the two participating schools, which amounts to 2450 students in total. First, the 2450 students are matched to the Microdata of Statistics Netherlands based on address, gender and date of birth. A total of 25 students cannot be matched because address, gender and date of birth do not uniquely identify them in the data (e.g. in the case of identical twins or immigrants). Of the 2425 remaining students that we can match to the microdata, 339 cannot be matched to the labor market data (i.e. household income and income from at least the parent that the student lives with in a household) that we need for our SES indicator, because we cannot identify their parents in the microdata or because the parents have missing information on the income data[6]. For five students we do not have all background information on previous performance, leaving us with a coverage of 85% (2081 students) of the students from the baseline sample.[7]

ii. Parental use of school administrative system

An important element of the context of our experiment regards the pre-existing means of digital follow-up offered to parents. Both schools have an electronic learning management system,

[6] The microdata shows that these parents do have a labour market status (e.g. employed, unemployed, on social benefits, etc.), and thereby an income, but that the income information is missing. Additional analyses show that this is not a selective sample with respect to student information, background data, or assignment to treatment.
[7] Note that this is higher than for example Golsteyn and Hirsch (2016), and Bee et al. (2016), who match between 76 and 81 percent of their original sample and who attribute the failure to link some individuals to the non-filing of taxes.

where among others students' background information, grades, schedule and homework are registered. Both schools have given parents access to the learning management system, such that parents can, for example, check on their child's homework and grades. Both schools have introduced the parental login in 2013/2014, and parents have received a once-only email at the start of that school year with some information and their login name. Parents of new students receive a similar email at the start of the school year when the child enters the school. The parents' email address(es) are also registered in this administrative system, and the schools use this to communicate with parents throughout the school year, additional to paper messages. On average, parents log in to this system about twice per week (an average of 48 times in the first semester, for the approximately 67% of parents that use their login at least once) , although there are differences between grade levels and SES-groups. Parents from lower grades log in more often whereas low SES-parents log in less often[8].

The number of logins provides interesting reference information for the parental involvement experiment, because it serves as a signal of involvement and more particularly of the willingness of parents to use an electronic instrument to get involved in the education process of their child. Therefore, we include this characteristic as a control in our analysis.

d. The Back office system of Mousework

i. Use of the homework tool

The main purpose of the parental app that is studied in this paper is to stimulate parental involvement and, by doing so, increase students' effort (use of the homework tool) and subsequent human capital development (math and language performance). The use of the homework tool was measured over the same period as the experiment with the parental app ran, namely between the pretest in September and the posttest in February. The first half of

[8] See Online Appendix 2 for more descriptive statistics on the use of the School Administrative System.

Table 1 shows the average amount of minutes students used the homework tool. Some students did not use it all, which influences the average amount of minutes. On average, students practiced 14 minutes per week during this period. However, the standard deviation is large, and therefore differences between students are very large. Note that students were asked to use the tool in total one hour (60 minutes) per week. Seventh grade students practiced the most and the difference between grade levels is significant. There are small, non-significant, differences between the SES groups, although there is more variation if we look at the differences between the separate grade levels both within and between SES groups (also significant). The second half of Table 1 shows the same statistics, but only for the students that practiced at least once. Now we see that the students who did use the tool have done so for an average of about 16 minutes. This statistic is higher for the 7th and 9th grade students (more than 16.5 minutes) than for 8th grade students. The distribution of the use of the homework tool in minutes is not normal, but skewed to the left, where there is a peak between 10 and 15 minutes and a declining number of students practicing more than 20 minutes.

[Table 1 around here]

ii. Math and language test data

The math and language skills are measured using digital standardized math and language tests, which are written by all students in September 2014 and February 2015. These are standardized validated tests developed by the company of the tool, and these tests are based on other nationally validated tests. The reliability (Cronbach's alpha scores of between .79 and .92) and validity of these tests is analyzed yearly by the tool developer, based on norm data of several participating schools (Schijf & Schijf, 2014). Although the pre and posttest are digital tests that are developed by the same company as the tool and are administered in the same digital

environment as the tool, the tests themselves are external to the practice exercise tool and do not contain any of the exercise questions. The tests measure whether students have mastered the required national numeracy and language level they are supposed to have, given their age and given the fact that they finished primary school (called 'reference level') and range between 0 and 200[9].

e. Questionnaires

During our study, both students and parents were asked to fill out a questionnaire. We wanted to get more insight in students' motivation for school in general, and asked questions on the courses mathematics and Dutch, on the program Mousework, on the time spent on homework, on their opinion on parental involvement and on their work attitude. The parental questionnaire contained background questions, a few questions on Mousework and the app, and eight statements on parental involvement in general. As not all students, nor all parents, filled out the questionnaires, the answers to the questionnaires are only used for explaining potential mechanisms[10].

4. Methodology

a. Identification strategy

To study the effect of the use of an app for parents on whether students do their digital homework and how much time they spent in the digital environment, a randomized field experiment was set up. As explained above, all students had a login account and were supposed to practice in the digital tool. First, students (and, hence, parents) were individually randomized into a treatment and control group, where treatment status implied that they could login to the

[9] More information the mathematics and language tests, as well as the descriptive statistics, can be found in the Online Appendix 2.
[10] More information the questionnaires, as well as on the response rates, can be found in Online Appendix 2.

app, and control status implied that it was technically impossible for them to log in the app with their child's login number. The randomization was done using a random number generator and classified students and their parents based on odd and even numbers. For practical (technical) reasons, and to avoid spill-over effects, siblings were supposed to have the same treatment status, so all children that had a sibling that belonged to the treatment group whereas they themselves did not were also added to the treatment group. This practical arrangement causes the selection likelihoods of students with siblings at school to be slightly higher than other students, but the actual impact of the latter is limited[11]. In effect, 55 percent of all children had parents that were able to actually login to the app (i.e. the treatment group). Because more than 2000 students are individually randomized (though clustered at the family level if discrepancies arose) we have a high enough number of observations to have confidence that we have randomly divided observed and unobserved characteristics of both students and parents. This is confirmed by a joint F-test on the available student parental and family characteristics, which shows no significant differences between students in treatment and control group. However, separate T-tests on all 28 characteristics, with a Bonferroni correction applied (accepted significance level of 0.002), show significant differences on four characteristics: school, immigrant generation of child and the birth year of both parents (see Table A4 in Online Appendix 1). Parents of students in the control group are slightly older than of students in the treatment group, students in the control group are slightly more often born abroad and we have slightly more students from school two in the control group. It is a priori unclear how these differences might influence the results.

[11] As a first check, we tested specifications including an indicator regarding the number of children at school. This does not change the effect estimates neither regarding practice behaviour, nor regarding math outcomes.

b. Compliance with Assignment

Evidently, providing parents with access to a tool does not guarantee its effective use. Moreover, parents had to download the app before they could even start using it to get involved. Table 2 describes the first step: the downloading. As explained earlier, the allocation of parents to the control or experimental group was only revealed after downloading[12]. Therefore, Table 2 refers to the full population of students (and their parents). Of 2086 students in the dataset, 20% of the parents downloaded the app. Similar to the use of the parents' portal of the learning management system and the response rates of the parent questionnaires, downloading happened more often among parents of 7th grade students (22%), decreasing gradually over parents of 8th grade students (19%) to 17% of the parents of 9th grade students. The separate statistics per SES group show that the download rate is the highest for the lowest SES group. The differences between grade levels and between SES groups are significant at the 5% level, but there are no significant interactions[13].

[Table 2 around here]

Table 3 reveal some information about the second step: the use of the app. The number of observations in Table 3 is far less than in Table 2, because of a double selection process: only one out of five parents effectively downloaded the app (see Table 2) and only roughly half of them had access to the tool, because of the randomization of the experiment (55%, see previous section).

[12] Note that the vast majority of parents downloaded immediately after the parental information nights, when the research was introduced. Almost all parents that did download did so long before autumn break, when students receive their first grade overview.

[13] Additional analyses show (see Table A5 of Online Appendix 1) that children from parents who downloaded the app have a higher score on the primary school ability test, are a bit younger (most likely because 7th grade students are overly represented in the group that did fill out the parental questionnaire) and have more often a stable home situation and a higher SES (and underlying variables).

Table 3 shows that complying parents (that both downloaded and used the app at least once) used the app on average 19 times during the period of the experiment, which is slightly more than once a week. When compared with the data of number of logins to the education management system, this may seem little, but the app is obviously much narrower in scope, as it refers to voluntary homework assignments in the ITS on math and language, instead of the full schooling process that is being registered in the education management system. We will return below to the association between both.

[Table 3 around here]

c. Instrumental Variable analysis

To identify the Average Treatment Effect (ATE) of access to the digital practice tool on minutes of digital homework and on test scores we use the notation first used by Rosenbaum and Rubin (1983). We observe a student *i's* total amount of minutes of digital homework or test score y_i and the treatment, a parents' access to the parental app, d_i, which results in the following equation:

$$y_i = d_i y_i(1) + (1 - d_i) y_i(0), \qquad (1)$$

Where $y_i(1)$ is the number of minutes spent on digital homework for students or the test score from treated parents and $y_i(0)$ is the amount of minutes spent on digital homework or the test score for students from untreated parents. Since the randomization ensures the independence between the treatment and potential outcomes, we identify the ATE as follows:

$$\tau_1 = E[y_i(1) - y_i(0)]. \qquad (2)$$

We can estimate the ATE using either simple *t*-statistics or using a linear regression. The linear regression is estimated as follows:

$$y_i = \alpha_0 + \alpha_1 d_i + \alpha_2 X_i + \varepsilon_i, \qquad (3)$$

Where d_i is the assignment to treatment of the parent(s) of student i, X_i are the students', parents' and family observable characteristics, such as ability variables, gender, age, income of parents, SES, et cetera, which are independent of the treatment, ε_i are the residuals at the student level which are assumed to be normally distributed with a mean of zero and a variance of σ^2.

However, the experiment provides parents with access to the app, but can of course not ensure that parents actually download and use the app. As we have seen in the section on compliance with the assignment, not all parents have downloaded the app and not all parents who have downloaded the app have actually used the app, making it technically an intent-to-treat effect (ITT) instead of an average treatment effect.

In order to control for the actual use of the app, we use a two-stage-least-squares (2SLS) instrumental variable approach to estimate the Local Average Treatment Effect (LATE) or, in other words, the treatment effect on the treated. Here we use the dummy that indicates the random assignment for access to the app as an instrument for the actual use of the app. The assignment to the treatment or control group is (highly) correlated with the use of the app, but uncorrelated with the error term, since the assignment was done randomly. The first stage is then estimated as follows:

$$p_i = \beta_0 + \beta_1 d_i + \beta_2 X_i + \varepsilon_i, \quad (4)$$

where p_i is the participation status. In the second stage, we use the predicted participation probability in the regression as follows:

$$y_i = \gamma_0 + \gamma_1 \hat{p}_i + \gamma_2 X_i + \varepsilon_i, \quad (5)$$

5. Results

a. The effect of the parental app on the use of the homework tool

Our main interest lies in the differential effect of the parental app by SES. However, before we look into that, we first present the results for the full sample of students, as well as the separate grade levels[14], to see if there is an effect for the overall population. Note that we only present multivariate regressions with a lot of covariates in the paper. However, we ran all analysis also without covariates, and the coefficients are very stable[15].

Full sample

Table 4 compiles the estimates for the immediate goal of the intervention, the practicing behavior of the students. In upper right corner, the effect of the provision of access to the smartphone app is shown under the heading ITT. We see that children react differently to the (potential) involvement of their parents depending on their age, which leads to an apparently insignificant overall effect, as well as for grade 7, but significant effects when looking at grades 8 and 9. In effect, the parental involvement enabled by the app leads 8th grade students to increase their practicing time with 2.6 minutes per week (over an average of 13, which is an effect with a magnitude of 0.2 of a standard deviation), while 9th grade students reduce their practicing time by 2.5 minutes (over an average of 12). This is an interesting finding that we will further look into when studying potential mechanisms in Section 7. Note that the size of the coefficient, as well as the average number of minutes practiced is quite small given that students were asked to practice 60 minutes per week and given that parents were actively informed about these 60 minutes. From a policy point of view, the ITT results are the most

[14] We have compared treatment and control group also per subsample that we analyze in this paper, and there are no significant differences on observables for the subsamples by grade level, SES or gender.
15 The regressions without covariates of Tables 5 can be found in Online Appendix 1 in Tables A6.

interesting results, as you can offer an app, as a policy, but you cannot force people to actually download and/or use the app.

However, given the rather meagre compliance rate we documented above, it is also of interest to look into the working mechanism more directly. To that end, we investigate whether the effective use of the app can be linked with the practicing intensity of the students. As a (descriptive) reference estimate, we report in the lower left corner of Table 4 a simple OLS result relating the dummy whether a parent used the app to the child's practicing. As could be expected, we obtain highly significant estimates. However, the direction of the relation is surprisingly homogeneous, we find positive relationships for all grade levels, where we would expect a negative sign for 9th grade students, based on the ITT. Actually, the difference between the ITT and OLS call for caution regarding selection effects. Therefore, we apply an instrumental variable approach with "access to the app" (randomized experimental condition) as the first stage instrument. Results regarding the first stage are shown in the upper left corner of Table 4. The instrument is significant for parents of students of all ages, because cross-over was literally technically impossible. However, due to non-compliance the coefficients are not that large. The actual effect of usage estimates (second stage estimates, LATE) are reflected in the lower right corner of Table 4. Parents of 8th grade students who are involved in their children's homework by getting access to the app make their children engage more in the homework tool. For 9th grade students, the generally negative effect revealed by the ITT-estimate, does not change. App-using by the parents is in this case related to students who practice less with the homework tool.

[Table 4 around here]

Differential effects by Socio Economic Status (SES)

Similar to previous studies, who have mainly focused on socially deprived students, we also look into different groups of students with respect to socio economics status. However, instead of only focusing on socially deprived, or low-SES students, we focus on all student by interacting the treatment dummy with the three groups of SES. We have split the sample in three groups, where we create a low-SES group (SES-group 1, lowest tertile), a medium-SES group (group 2, middle tertile) and a high-SES group (group 3, highest tertile)[16], based on the previously discussed SES-variable that we have created based on the data from Statistics Netherlands. The results of the 1st stage, ITT, OLS and second stage analyses for all three SES-groups are presented in Table 5. All first stages are highly significant. The ITT in the upper right corner shows that the positive effect in grade 8 seems to be driven by low-SES students, whereas the negative effects in grade 9 are present for both low and high-SES students (but not for middle-SES students). The effect of parents having access to the app for low SES-students in grade 8 is around 6.5 minutes per week of increased practice time (equivalent to an effect of 0.4 of a standard deviation). The second stages show similar significant results but have very high coefficients, most likely due to the low first stage coefficients and the large differences within the low-SES groups (as there are many students in this group that have not practiced at all). We checked whether the large coefficients of the second stage were due to outliers on the number of times parents checked the app and/or on the number of minutes the child practiced in the tool. However, the large coefficients and significant results remained even after deleting all 30 parents that checked the app more than 40 times (more than twice as much as we asked), after deleting all 36 students that practiced more than 60 minutes per week (which was what the school asked for) and after deleting both (where only 2 students belonged to both groups). We have also performance additional checks with the logarithm of minutes practiced, to trim potential outliers in the dependent variable, but the coefficients in the second stage remain very

[16] Other ways of defining the SES-groups, as well as other proxies for SES, will be tested and discussed in the robustness analyses.

large[17]. We also inspected the data for the complying parents and students in the low-SES group, but there are no extreme or strange outliers in his group. Furthermore, the results are not based on only a few (active) parents and students, as the share of parents within this SES-group that uses the app is only slightly lower than for the other SES-groups.

However, since the ITT is much more interesting from a policy point of view, we have decided to focus on the ITT results in the remainder of this paper[18].

[Table 5 around here]

Next, we look at subsamples for gender. Table 6 presents the ITT-results[19] of the analyses separately for male and female students. Table 6 shows that the positive effect of parental app use on students' use of the homework tool in grade 8 is larger for male than for female students, but is significant at the 5 percent level for both males and females. The negative significant effect for grade 9 students seems to be driven by girls, for both the low and high SES-group, and especially the low-SES group. Potential mechanisms for this finding are explored in Section 7.

[Table 6 around here]

[17] Results of these additional checks can be found in Online Appendix 1 Table A7.
[18] Note that we checked whether the unrealistically large coefficients were due to outliers on the number of times parents checked the app and/or on the number of minutes the child practiced in the tool. However, the large coefficients and significant results remained even after deleting all 30 parents that checked the app more than 40 times (more than twice as much as we asked), after deleting all 36 students that practiced more than 60 minutes per week (which was what the school asked for) and after deleting both (where only 2 students belonged to both groups). We have also added robustness checks with the logarithm of minutes practices, to trim potential outliers in the dependent variable, which shows a similar picture. Nonetheless, we find our ITT results more interesting.
[19] The full tables with first stages, OLS and 2SLS-results can be found in Online Appendix 1 (Tables A8 and A9).

b. The effect of the parental app on math and language performance

The outcome we discussed so far is the immediate goal of the intervention, but also an instrumental one. Ultimately, the goal of the innovation of the teaching process by using the homework tool and getting parents to help motivate students to use it, is the improvement of skills. It is important to mention that we only register whether parents log in to the app, but that we cannot see whether they look at the math or language performance and use of the homework tool of their child. Therefore, so far, we have focused on use of the homework tool in general, without making the distinction between math and language, as we cannot say anything about that. However, performance of students is measured for math and language separately and as these are two very different domains of performance, we will analyze them separately here.

Tables 7 summarizes the main results[20], first for math and language in general, and in the second half of the table split by gender. In the first part of table 7, for math, we see that the ITT estimates suggest that the stimulus to parental involvement given by the app is effective in raising the math performance of 8th grade students (of both the lower and the middle SES groups) with about 0.2 of a standard deviation and the language performance of 7th grade students in the lower SES group with about 0.1 of a standard deviation. The negative effect on usage for 9th grade students that we discussed in the previous tables seems to mostly harm the language performance of low-SES students.

[Table 7 around here]

The second part of Table 7 shows that all the previously mentioned results for math and language seem to be driven by boys. We do not see any significant effect for girls. The lack of a significant effect for female students could of course be a power problem, given the low

[20] The full tables with first stages, OLS and 2SLS-results can be found in Online Appendix 1 (Tables A10 – A15).

number of observations. However, there are fewer males than females in the sample, and the coefficients are much larger for males than for females. Therefore, even if we *do* have a power problem and there potentially is an effect for females as well, we can conclude that the effect is much larger for male students. Potential mechanisms for the findings on performance, SES and gender are explored in Section 7.

6. Robustness analyses

As robustness analyses, of which all the results can be found in Table 8, we first of all have defined the SES-groups differently (results in Table 8[21]). We now do not create equally sized SES-groups but use the mean and standard deviation to create groups. We separate the SES-groups by defining the group borders by half a standard deviation around the mean on both sides and a full standard deviation around the mean. These analyses confirm the finding of the positive effect in grade 8 and the negative effect in grade 9 for low-SES students. In a next robustness check, we add controls on parental involvement taken from the student questionnaire. This substantially reduces the sample in size, but adds information on how much involvement students *want* from their parents. Again, the results are not very different. Next, we do not create tertiles by SES, but quartiles. In these results, we find that the previously found effects in grades 8 and 9 are still driven by the lowest SES-group. We do not find significant results for the other three groups, except for the second lowest SES group for the total sample of students. Next, we do not use SES but the four categories of educational level of the mother. Given that the fourth category defines individuals for whom we have missing parental education information, the first three categories confirm our findings, namely that the positive effect is only found for children of lower educated mothers. Note that there are very few mothers in the lowest level of education category, especially for 8 and 9th grade. Lastly,

[21] All results presented in Table 8 are ITT results.

we have clustered standard errors at the class level in one analysis, and at the school level in another analysis, and these analyses also show almost identical significance results as before. All in all, our robustness checks give confidence that our results and conclusions with respect to SES are robust and not dependent on specifications chosen or variables used.

[Table 8 around here]

7. Mechanisms

a. Differential results by grade level and gender

In order to get an idea about the mechanisms behind the effects that we found above in Section 5, we ran correlations between the answers of students in the student questionnaire, about the (desired level of) parental involvement, and the answers of parents in the parental questionnaire, about their involvement.

The positive effects for 8th grade students can be explained by the findings from the correlations analyses[22], which show that these age groups of students are still more inclined to listen to their parents and accept parental involvement. We find that 8th grade students who would like more help also get more help with homework from their parents. On the other hand, if we look at 9th grade students, where we find a negative effect of parental involvement on using the homework tool, these students are already adolescents who accept less from their parents and are often obstreperous. Ninth grade students practice less if parents help more with homework, if parents feel they need more help and if parents try to help them if their motivation is gone. Furthermore, if 9th grade students feel that parents should interfere less they also practice less. These findings indicate the obstreperous behavior of the 9th grade students that in turn may explain the earlier findings on the effect of the use of the app by parents. It is also in

[22] See Online Appendix 3 for descriptive statistics and a discussion on these correlations

line with previous findings regarding the link between parental involvement and student behavior reported on in the literature (Hoover-Dempsey et al., 2001; Patall et al., 2008).

Therefore, a second potential mechanism that relates to the one discussed above seems to be difference in biological development. Grade 9 students have already entered puberty whereas grades 7 and 8 students in general have not. As the biological development is age related, we have also split the sample by age group instead of by grade, which is shown in Table 9. Here we see similar results as to when we split the sample by grade level, supporting the hypothesis that grade 9 students respond in a complete adverse way to parental involvement.

Next, we look into potential reasons why the effects are more prevalent for male students. In these analyses (not visible in table 9) we see a similar pattern in the answers to the questionnaires of students and their parents. We see a larger discrepancy in the answers between parents and students for girls than for boys. This could be explained because girls enter puberty earlier than boys and might therefore be less inclined to listen to their parents to practice in the online tool.

[Table 9 around here]

b. Differential results by SES

Lastly, we want to dig deeper into why the effect is mainly present for low-SES students. Therefore, we run additional regressions, correlations and descriptive statistics to explore potential reasons why the effect is mainly present for low-SES students[23].

[23] The results of these additional analyses are presented in Tables C2-C7 in Online Appendix 3.

These analyses show that for grades 7 and 8, in the low-SES group, there is a much larger difference between the minutes practiced by children whose parents used the app and children whose parents did not use the app, than for the other two SES groups. For grade 9, the difference is smaller for the low-SES group, than for the other two groups. Although in the low-SES group the number of parents that have used the app is smaller than in the other groups, these parents and/or children seem to have listened better to the instructions of children having to practice 60 minutes per week in total. As discussed before, this might also mean that the 2SLS effects we find are driven by a small number of individuals.

Furthermore, we find that in the low-SES group, in the parental questionnaire, parents indicate significantly less frequently that their children need little help. On the other hand, children in the low-SES group report less often that they want less interferences by their parents on school related issues. This might point at a better match between needs of children and their parents view on their needs.

We also find that that parents who downloaded the app in the low SES-group are more likely to talk to their children at school (in comparison with a negative, and not significant, correlation for the other two SES-groups), and more often help their child with their homework (although not significant). So these seem to be the more involved parents. Next, we hypothesized that high-SES parents might use the school administrative system more often and therefore feel that they do not need the app. Here, we find that, although the low-SES group shows a higher correlation between using the school admin system and the app (in both cases, using it at all) than the other groups, this is still a small correlation, and there is no correlation between the number of times both systems are used. So the latter does not seem to be a potential explanation for the differences in found effects.

The additional analyses also show that in the low-SES group, there is a smaller share of parents in the treatment group, compared with the other two groups. Furthermore, low-SES

parents less often filled out the questionnaire, downloaded the parental app, and used the parental app. This might point at a selective group of parents that downloaded and used the app, even more so in the low-SES group. However, there does not seem to be a substitution effect in digital involvement, as these analyses also show that there is no significant difference in the number of times parents logged into the school admin system and the number of minutes the students practiced per week, between the three SES groups.

Correlations between SES and app use and download behavior show that *within* the low-SES group, there is no difference in the educational level of the mother with respect to who used and downloaded the app. We do see that SES within the low-SES group is a little higher for app users and downloaders, but the correlation is less than 0.1 and only significant for app downloads.

Furthermore, we also find that in the low-SES group there is a low and insignificant correlation for whether the parents used the app, and whether the child is the younger (either youngest, or middle child) or the oldest child, whereas for the other two SES groups younger children are less likely to have parents that used the app. We also see that for the low-SES group there hardly is a difference for children who are the younger or oldest child in whether they would like less interference by their parents, whereas for the other two SES-groups there is a larger difference between the younger and oldest children.

In line with this, we find that the positive effects are larger and more significant for younger children than for older children. This can be related to the literature that says that older children get more attention by their parents (by default, because they were born earlier) (Cabus & Ariës, 2017), meaning that younger children have much more to gain from increased parental involvement. Since in the low-SES group we find that younger children are much more likely to have a parent that uses the app, in comparison with the other two SES-groups, this could be one of the explanations for the effect we find.

8. Conclusion and Discussion

In this paper we analyzed the effect of parental involvement on the use of a digital homework practice tool and on math performance of all students in grade 7 to 9 of two secondary schools in the Netherlands, with a specific focus on differences between Socio Economic Status groups. The experiment consisted of an app in which parents can follow their child's practice behavior in the digital homework tool, using a randomized field experiment at the individual level. For additional information on parental involvement both students and parents were asked to fill out a questionnaire.

We focus the analysis of the results from the viewpoint of the provision of access to the tool ("Intent to Treat", ITT), the most policy relevant part, and show that parental involvement via app-use positively affects practice behavior of 8th grade students, but negatively affects practice behavior of 9th grade students. Furthermore, we find positive effects of app use on students' language and mathematics score at the end of the experiment, which is driven by the 7th and 8th grade students, respectively.

Subgroup analyses show that the positive and significant effects that are found (both on the use of the homework tool for grade 8 and on math and language performance) are more prevalent for male students and are mostly driven by the low-SES students, whereas the negative effect of the parental app on the use of the homework tool in grade 9 is also due to the high-SES students.

As such, our results add to the rather limited existing experimental literature on interventions to raise parental involvement. In contrast with intensive interventions like those reported about by Bergman (2019) and Mayer et al. (2018), giving access to a parent app linked to an existing digital homework tool, requires little effort for the school and the teachers. Nevertheless, it proved effective in raising involvement and beneficial to the learning progress of the students.

A potential explanation for our findings with respect to SES could be that an app might be less socially selective (in terms of parental SES and parental education) than for example an intervention that fosters the use of specific books or other educational techniques that require a high education of parents. Apps are used by everybody and might be a lot more appealing to low-SES parents than more traditional interventions.

Both the parental and the student questionnaire shed additional light on how students and parents experience parental involvement and how students feel about that. For 7th and 8th grade students, parents and students are very much aligned with respect to their needs and offers of parental involvement, whereas there is a clear discrepancy in this for 9th grade students and their parents, which might have to do with the puberty age of 9th grade children. This is confirmed by the analysis that we provided by age, instead of by grade level: for younger children we find the positive effect and for older children we find the negative effect.

The difference in findings between the different grade levels and the different-SES groups is intriguing and one could wonder whether there would be a substitution effect where high-SES parents use different ways of parental involvement than our app. We looked into many potential mechanisms in the final part of this paper and although we do see some differences between the SES groups, the results do not point towards a substitution effect.

For example, we hypothesized that high-SES parents might use the school administrative system more often and therefore feel that they do not need the app. However, if we check the data, we do not see any correlation between SES-status (neither high nor low SES-status) and use of the school administrative system. Furthermore, one could argue that high-SES parents that use the app are more effective for the use of the homework tool by their children, because high-SES children might already perform quite well, and therefore do not need to practice that often. However, here again the data shows that this is not the case, there

does not seem to be a relationship between SES-status and performance levels for math and language.

Also, one could argue that more involved, high-SES parents might be less inclined to download the app in the first place, because they realize they only have a 50% chance of belonging to the treatment group, and they rather invest their energy in other involvement with their child's school career. And although we see that high-SES parents are slightly more likely to download and use the app, we do not see differences in background characteristics of these parents that are likely candidates to explain these differences (such as parental education, or the use of the school admin system, as discussed above).

All in all, there does not seem to be a substitution effect that can explain our finding that the effect of parental involvement on student homework behavior are mainly found for low-SES students. It is possible that the specific question of the school to be involved as a parent by using the app on the smartphone has specifically triggered low-SES parents who are not so much involved just by intrinsic motivation, whereas medium and high-SES parents are more intrinsically motivated to be involved anyway. The differences between the low-SES group and the other groups with respect to filling out the questionnaire, downloading the app and using the app also potentially point towards a selective group of parents in the low-SES group, but this is once more not confirmed by the data, showing that there is no difference in educational level between the groups, nor within the low-SES group.

However, we do see some patterns in the mechanisms analyses that might explain our findings. First of all, there seems to be a better match in the needs and offers of parental involvement by children and parents for 7^{th} and 8^{th} grade students. Furthermore, it seems that the ranking of the child in the family also plays a role in this. Literature has shown that younger children have much more to gain from increased parental involvement. Since younger children in the low-SES group are much more likely to have a parent that uses the app, in comparison

with the other two SES-groups, this could be one of the explanations for the effect we find. We also see that the effect for younger children is larger and more significant in the low-SES group. It is likely that the younger children in the low-SES groups have even more to gain than the average younger child, as parental involvement is generally lower in the low-SES group. Future research should look further into this, but it does seem that if low-SES parents can be persuaded to be more involved in their children school work, they will do so for all their children equally, whereas parents in the other two SES groups are significantly less likely to be involved through an app for their younger children than for the oldest child.

In sum, the provision of a smartphone-based follow-up app for parents proves to foster homework activities as well as performance of students, especially in low-SES families and in the early years of secondary education. This implies that parental involvement can easily be increased for low-SES families as well, using technology and specifically asking for it, resulting in positive effects for those students that could often use an additional help to focus on their school.

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Tables and Figures

Figure 1 – Timeline of the Experiment

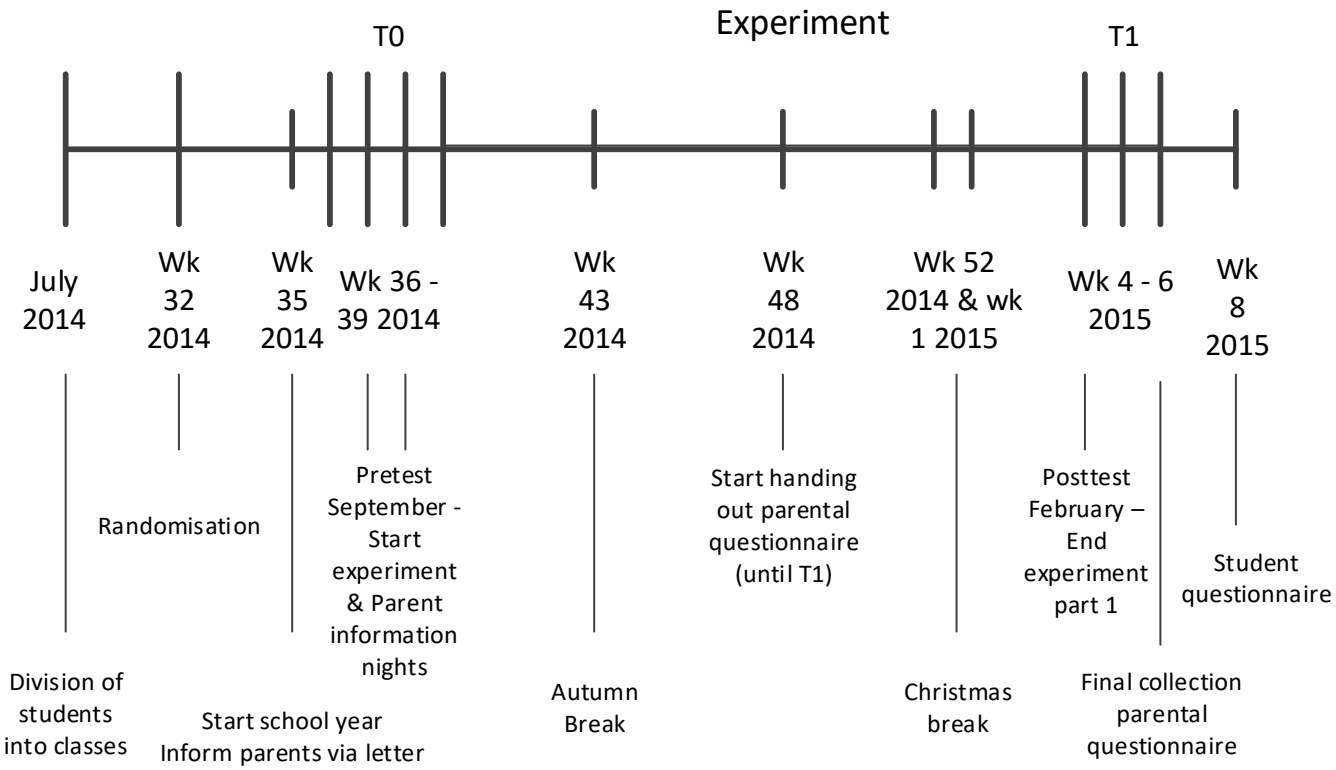

Table 1 – Practice time in online homework tool (complete experimental period)

	Obs	Average	St. Dev
Total minutes practiced	2,086	13.88	15.18
Total minutes practiced (grade 7)	740	16.34	16.30
Total minutes practiced (grade 8)	736	12.83	14.19
Total minutes practiced (grade 9)	610	12.16	14.56
SES 1	Obs	Average	St. Dev
Total minutes practiced	676	13.51	15.68
Total minutes practiced (grade 7)	243	13.15	14.99
Total minutes practiced (grade 8)	253	18.72	17.94
Total minutes practiced (grade 9)	244	17.05	15.31
SES 2	Obs	Average	St. Dev
Total minutes practiced	686	13.99	15.42
Total minutes practiced (grade 7)	234	14.74	16.11
Total minutes practiced (grade 8)	241	11.29	12.80
Total minutes practiced (grade 9)	261	12.53	13.41
SES 3	Obs	Average	St. Dev
Total minutes practiced	724	14.11	14.48
Total minutes practiced (grade 7)	199	12.49	15.97
Total minutes practiced (grade 8)	192	11.15	13.25
Total minutes practiced (grade 9)	219	12.73	14.33

WHEN PRACTICED AT ALL

	Obs	Average	St. Dev
Total minutes practiced	1,810	15.99	15.23
Total minutes practiced (grade 7)	693	17.45	16.26
Total minutes practiced (grade 8)	671	14.07	14.26
Total minutes practiced (grade 9)	446	16.62	14.68
SES 1	Obs	Average	St. Dev
Total minutes practiced	567	16.10	15.85
Total minutes practiced (grade 7)	212	15.07	15.11
Total minutes practiced (grade 8)	246	19.26	17.91
Total minutes practiced (grade 9)	235	17.70	15.23
SES 2	Obs	Average	St. Dev
Total minutes practiced	602	15.95	15.49
Total minutes practiced (grade 7)	213	16.19	16.17
Total minutes practiced (grade 8)	216	12.60	12.90
Total minutes practiced (grade 9)	242	13.52	13.44
SES 3	Obs	Average	St. Dev
Total minutes practiced	641	15.94	14.41
Total minutes practiced (grade 7)	142	17.50	16.43
Total minutes practiced (grade 8)	140	15.30	13.31
Total minutes practiced (grade 9)	164	17.00	14.19

Table 2 – Download statistics app

	Obs	Average	St. Dev
Downloaded parental app	2,086	0.20	0.40
Downloaded parental app (grade 7)	740	0.22	0.42
Downloaded parental app (grade 8)	736	0.19	0.39
Downloaded parental app (grade 9)	610	0.17	0.37
SES 1	Obs	Average	St. Dev
Downloaded parental app	676	0.16	0.37
Downloaded parental app (grade 7)	243	0.19	0.40
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Downloaded parental app	686	0.21	0.41
Downloaded parental app (grade 7)	234	0.16	0.37
Downloaded parental app (grade 8)	241	0.19	0.39
Downloaded parental app (grade 9)	261	0.21	0.41
SES 3	Obs	Average	St. Dev
Downloaded parental app	724	0.21	0.41
Downloaded parental app (grade 7)	199	0.13	0.34
Downloaded parental app (grade 8)	192	0.20	0.40
Downloaded parental app (grade 9)	219	0.18	0.38

Table 3 – Usage statistics app

	Obs	Average	St. Dev
Number of times used parental app	228	18.82	30.60
Number of times used parental app (grade 7)	92	17.30	19.92
Number of times used parental app (grade 8)	75	18.59	26.55
Number of times used parental app (grade 9)	61	21.39	45.40
SES 1	Obs	Average	St. Dev
Number of times used parental app	49	17.33	23.26
Number of times used parental app (grade 7)	19	16.74	17.02
Number of times used parental app (grade 8)	36	19.44	22.32
Number of times used parental app (grade 9)	37	15.51	19.12
SES 2	Obs	Average	St. Dev
Number of times used parental app	87	22.14	40.64
Number of times used parental app (grade 7)	18	22.28	31.60
Number of times used parental app (grade 8)	28	15.54	21.77
Number of times used parental app (grade 9)	29	19.24	27.95
SES 3	Obs	Average	St. Dev
Number of times used parental app	92	16.48	21.73
Number of times used parental app (grade 7)	12	10.83	16.00
Number of times used parental app (grade 8)	23	34.39	69.70
Number of times used parental app (grade 9)	26	14.77	17.46

Table 4 – The effect of parental use of the app on students' use of the homework tool

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment	0.200***	0.225***	0.189***	0.192***	0.562	1.347	2.607*	-2.554*
	(0.0130)	(0.0231)	(0.0215)	(0.0235)	(0.665)	(1.207)	(1.033)	(1.203)
N	2081	740	733	608	2081	740	733	608
R-squared					0.037	0.052	0.093	0.043
F-statistic	237.52	94.31	71.62	62.16	3.756	2.091	3.862	1.402
	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used	9.227***	11.11***	9.320***	6.524**	2.809	5.997	13.82**	-13.27*
	(1.050)	(1.783)	(1.685)	(1.988)	(3.277)	(5.197)	(5.342)	(6.610)
N	2081	740	733	608	2081	740	733	608
R-squared	0.071	0.099	0.123	0.053	0.055	0.089	0.114	-0.106
F-statistic	7.538	4.175	5.255	1.744	3.826	2.175	3.952	1.213

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, year

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 5 – The effect of parental use of the app on students' use of the homework tool – By SES

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.140***	0.164***	0.144***	0.108***	1.018	0.989	6.469***	-6.261***
	(0.011)	(0.019)	(0.019)	(0.019)	(1.162)	(2.090)	(1.818)	(2.091)
Assignment experiment SES 2	0.211***	0.250***	0.178***	0.202***	1.576	1.971	0.472	3.054
	(0.014)	(0.025)	(0.024)	(0.026)	(1.167)	(2.061)	(1.818)	(2.126)
Assignment experiment SES 3	0.227***	0.251***	0.212***	0.230***	-0.847	0.825	1.035	-4.118**
	(0.014)	(0.025)	(0.023)	(0.025)	(1.131)	(2.121)	(1.721)	(1.991)
N	2081	740	733	608	2081	740	733	608
R-squared					0.071	0.108	0.107	0.062
F-statistic	54.35	25.20	18.61	10.44	6.271	3.771	3.689	1.670
	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	11.808***	17.063***	18.116***	-3.197	7.311	5.995	44.751***	-57.697**
	(2.216)	(3.833)	(3.366)	(4.378)	(8.219)	(12.295)	(12.702)	(22.464)
Dummy app used SES 2	8.880***	10.180***	6.041**	9.251***	7.512	7.955	3.359	15.484
	(1.687)	(2.845)	(2.683)	(3.183)	(5.479)	(7.977)	(10.292)	(12.175)
Dummy app used SES 3	7.488***	8.281***	6.084**	8.277***	-3.836	3.268	4.155	-17.697*
	(1.648)	(2.845)	(2.647)	(3.035)	(4.926)	(8.159)	(8.193)	(10.037)
N	2081	740	733	608	2081	740	733	608
R-squared	0.047	0.093	0.138	0.063	0.038	0.059	0.059	-0.310
F-statistic	3.289	2.025	4.920	1.719	3.257	1.952	3.502	1.197

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 6 – The effect of parental use of the app on students' use of the homework tool – By gender

	Boys				Girls			
	ITT ; dependent: Number of times the child used the homework tool							
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	2.228	2.426	7.547**	-3.280	0.217	-1.100	5.328**	-7.831***
	(1.810)	(3.205)	(3.007)	(3.123)	(1.528)	(2.809)	(2.334)	(2.896)
Assignment experiment SES 2	1.748	4.586	-1.709	1.784	1.443	-0.368	2.541	3.224
	(1.780)	(3.152)	(2.688)	(3.355)	(1.557)	(2.749)	(2.505)	(2.840)
Assignment experiment SES 3	0.242	3.237	1.158	-2.088	-1.923	-1.218	1.271	-6.145**
	(1.672)	(3.201)	(2.594)	(2.840)	(1.544)	(2.859)	(2.355)	(2.838)
N	914	344	314	256	1167	396	419	352
R-squared	0.083	0.167	0.113	0.130	0.072	0.116	0.128	0.068
F-statistic	3.355	2.916	1.685	1.589	3.685	2.217	2.644	1.089

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 7 – The effect of parental use of the app on student math and language performance (in total and by gender)

	Math				Language			
	ITT ; dependent: Number of times the child used the homework tool							
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	1.472	0.560	4.788**	0.621	-2.473	3.627*	-2.070	-6.147**
	(1.030)	(1.373)	(1.981)	(1.604)	(1.910)	(2.122)	(3.685)	(2.482)
Assignment experiment SES 2	1.855*	0.385	5.498***	-1.311	-0.139	-0.339	1.619	1.761
	(1.000)	(1.300)	(1.927)	(1.581)	(1.859)	(1.944)	(3.667)	(2.481)
Assignment experiment SES 3	0.150	0.148	0.139	1.793	-0.783	-2.355	0.517	3.003
	(0.962)	(1.332)	(1.816)	(1.468)	(1.756)	(1.958)	(3.407)	(2.232)
N	1920	678	677	565	1709	599	596	514
R-squared	0.906	0.425	0.531	0.574	0.676	0.575	0.561	0.856
F-statistic	701.936	20.106	30.772	30.305	134.674	32.394	30.438	121.186

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 7 – The effect of parental use of the app on student math and language performance (in total and by gender) - continued

	Boys							
	Math				Language			
	ITT ; dependent: Number of times the child used the homework tool							
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	3.606**	0.903	8.203**	1.503	-1.292	7.060**	-1.759	-6.864*
	(1.658)	(2.028)	(3.321)	(2.699)	(2.989)	(3.273)	(6.046)	(3.770)
Assignment experiment SES 2	1.922	-0.010	8.477***	-4.419	1.000	2.819	-1.052	-0.691
	(1.586)	(1.899)	(2.989)	(2.841)	(2.884)	(3.031)	(5.507)	(3.993)
Assignment experiment SES 3	0.196	0.617	2.812	1.574	-1.787	-2.335	1.935	1.509
	(1.467)	(1.919)	(2.820)	(2.358)	(2.639)	(3.019)	(5.180)	(3.252)
N	842	316	290	236	753	275	254	224
R-squared	0.906	0.458	0.571	0.626	0.681	0.589	0.618	0.877
F-statistic	313.830	10.734	15.410	15.437	62.154	15.609	16.151	61.803
	Girls							
	Math				Language			
	ITT ; dependent: Number of times the child used the homework tool							
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	-0.241	0.573	2.177	-1.073	-3.500	0.588	-1.205	-4.626
	(1.325)	(1.927)	(2.507)	(2.042)	(2.500)	(2.912)	(4.814)	(3.375)
Assignment experiment SES 2	1.500	1.098	3.259	0.311	-0.649	-1.031	4.649	2.279
	(1.299)	(1.826)	(2.566)	(1.916)	(2.460)	(2.641)	(5.072)	(3.207)
Assignment experiment SES 3	0.133	0.722	-1.463	1.813	0.485	-2.840	-0.557	5.177*
	(1.290)	(1.897)	(2.428)	(1.934)	(2.369)	(2.660)	(4.665)	(3.105)
N	1078	362	387	329	956	324	342	290
R-squared	0.908	0.431	0.525	0.555	0.679	0.587	0.540	0.854
F-statistic	413.866	11.118	17.409	16.549	78.672	18.515	16.224	67.668

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 8 – Robustness analyses

ITT	SES groups defined based on + and - 0.5 SD				SES groups defined based on + and - 1 SD				Including controls on parental involvement from student questionnaire			
	dependent: Number of times the child used the homework tool											
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	1.052	1.908	6.192***	-6.934***	0.977	0.675	5.448**	-4.682*	1.414	1.988	8.281***	-8.960***
	(1.230)	(2.237)	(1.885)	(2.246)	(1.564)	(2.897)	(2.434)	(2.795)	(1.565)	(3.066)	(2.067)	(2.794)
Assignment experiment SES 2	0.726	1.455	2.096*	-1.089	0.637	1.572	2.484**	-2.199*	1.420	1.940	-1.090	3.747
	(0.800)	(1.453)	(1.265)	(1.412)	(0.728)	(1.320)	(1.139)	(1.315)	(1.421)	(2.629)	(1.999)	(2.511)
Assignment experiment SES 3	-0.576	-0.074	-0.502	-2.071	-0.324	0.099	0.435	-2.489	-0.619	3.349	1.846	-7.750***
	(1.289)	(2.293)	(2.058)	(2.339)	(1.481)	(2.666)	(2.436)	(2.622)	(1.378)	(2.681)	(1.839)	(2.479)
N	2081	740	733	608	2081	740	733	608	1350	473	504	373
R-squared	0.037	0.059	0.106	0.054	0.037	0.059	0.101	0.046	0.053	0.118	0.161	0.195
F-statistic	3.199	1.966	3.658	1.444	3.174	1.961	3.467	1.217	2.640	2.298	3.518	3.221

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 8 – Robustness analyses – continued

ITT	4 SES groups dependent: Number of times the child used the homework tool					4 groups education level mother dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9		Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.992	2.342	6.355***	-7.728***	Assignment experiment educ level mother 1 (primary or secondary educ)	15.309***	24.357***	-10.872	6.646
	(1.219)	(2.226)	(1.886)	(2.187)		(4.577)	(6.205)	(13.766)	(8.696)
Assignment experiment SES 2	2.140**	2.110	2.059	2.199	Assignment experimentused educ level mother 2 (upper sec or vocational educ)	7.589***	10.531***	6.061*	5.140
	(1.065)	(1.905)	(1.668)	(1.940)		(2.127)	(3.948)	(3.136)	(3.952)
Assignment experiment SES 3	0.095	0.088	1.848	-0.866	Assignment experiment used educ level mother 3 (higher educ)	2.916	5.141	3.783	-2.032
	(1.093)	(2.036)	(1.664)	(1.932)		(2.096)	(3.413)	(3.294)	(4.340)
Assignment experiment SES 4	-0.987	0.350	0.137	-3.611*	Assignment experiment used educ level mother 4 (missing)	12.141***	12.133***	14.000***	10.428***
	(1.171)	(2.138)	(1.859)	(2.050)		(1.518)	(2.635)	(2.428)	(2.788)
N	2081	740	733	608	N	2081	740	733	608
R-squared	0.039	0.060	0.106	0.069	R-squared	0.077	0.113	0.137	0.063
F-statistic	3.214	1.905	3.502	1.787	F-statistic	6.549	3.809	4.700	1.641

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 8 – Robustness analyses – continued

	standard errors clustered at class level				standard errors clustered at school level			
ITT	dependent: Number of times the child used the homework tool							
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	1.018	0.989	6.469***	-6.261***	1.018	0.989	6.469**	-6.261**
	(1.103)	(1.491)	(1.867)	(1.764)	(0.390)	(1.585)	(0.460)	(0.293)
Assignment experiment SES 2	1.576	1.971	0.472	3.054	1.576	1.971	0.472	3.054*
	(1.134)	(2.255)	(1.666)	(1.886)	(1.434)	(1.416)	(1.860)	(0.271)
Assignment experiment SES 3	-0.847	0.825	1.035	-4.118**	-0.847	0.825	1.035	-4.118
	(1.141)	(2.180)	(1.499)	(1.952)	(0.680)	(4.996)	(0.746)	(0.806)
N	2081	740	733	608	2081	740	733	608
R-squared	0.071	0.108	0.107	0.062	0.071	0.108	0.107	0.062
F-statistic	4.096	12.936	4.802	2.749	4.096	12.936	4.802	2.749

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

clustered standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 9 – Regression analyses split by age group instead of grade level

	ITT			
	dependent: Number of times the child used the homework tool			
	Total	Age 12	Age 13	Age 14
Dummy app used SES 1	1.018	1.815	3.794*	-5.391**
	(1.162)	(2.308)	(1.972)	(2.219)
Dummy app used SES 2	1.576	1.809	0.486	0.959
	(1.167)	(2.206)	(1.904)	(2.416)
Dummy app used SES 3	-0.847	0.719	1.753	-4.621**
	(1.131)	(2.098)	(1.897)	(2.293)
N	2081	626	746	511
R-squared	0.038	0.055	0.098	-0.231
F-statistic	3.257	1.584	2.025	0.984

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Online Appendix 1

Table A1 – Comparison of unmatched and matched students in Microdata of Statistics Netherlands

Randomisation full sample	atistics Netherland	tistics Netherlands s						
	Average	SD	Obs	Average	SD	Obs	Average difference	T-Stat	P-avlue
Primary school ability test total score	535.86	9.34	339	536.39	8.94	2086	-0.54	-1.02	0.31
Female	0.54	0.50	339	0.56	0.50	2086	-0.02	-0.72	0.47
Birth country (0=NL, 1=other)	0.92	0.27	339	0.98	0.15	2086	-0.05	-5.19	0.00
Age (in full years)	12.94	1.08	339	12.92	0.96	2086	0.02	0.33	0.74
Situation at home (0=both parents at home, 1=parents divorced or one parent deceased)	0.80	0.40	339	0.84	0.37	2086	-0.04	-1.86	0.06
school	1.43	0.50	339	1.50	0.50	2086	-0.07	-2.27	0.02
Socio Econ Status at neighborhood level	-0.03	0.81	332	-0.06	0.87	2081	0.02	0.45	0.65
Grade 7	0.39	0.49	339	0.35	0.48	2086	0.04	1.34	0.18
Grade 8	0.29	0.46	339	0.35	0.48	2086	-0.06	-2.08	0.04
Grade 9	0.31	0.46	339	0.29	0.45	2086	0.02	0.76	0.45

Table A2 – Comparison of students that did and did not fill out the student questionnaire

Student Questionnaire	Did not fill out			Filled out					
TOTAL	Average	SD	Obs	Average	SD	Obs	Average difference	T-Stat	P-avlue
Primary school ability test total score	535.55	9.39	708	536.83	8.67	1378	-1.28	-3.10	0.00
Female	0.57	0.50	708	0.56	0.50	1378	0.01	0.64	0.52
Birth country (0=NL, 1=other)	0.97	0.17	708	0.98	0.14	1378	-0.01	-1.22	0.22
Age (in full years)	12.95	1.00	708	12.90	0.94	1378	0.05	1.22	0.22
Situation at home (0=both parents at home, 1=parents divorced or one parent deceased)	0.78	0.42	708	0.87	0.33	1378	-0.10	-5.67	0.00
school	1.71	0.46	708	1.39	0.49	1378	0.31	14.13	0.00
Socio Econ Status at neighborhood level	-0.21	1.01	707	0.02	0.78	1374	-0.23	-5.84	0.00
Grade 7	0.36	0.48	708	0.35	0.48	1378	0.01	0.37	0.71
Grade 8	0.32	0.47	708	0.37	0.48	1378	-0.05	-2.40	0.02
Grade 9	0.32	0.47	708	0.28	0.45	1378	0.04	2.13	0.03
Father has a job	0.85	0.36	708	0.90	0.30	1378	-0.05	-3.71	0.00
Mother has a job	0.80	0.40	708	0.85	0.36	1378	-0.05	-3.17	0.00
Household income	174655.44	1063759.80	708	228298.04	663970.53	1378	-53642.60	-1.41	0.16
Income father	53720.82	47774.91	669	52591.43	38526.13	1346	1129.39	0.57	0.57
Income mother	21769.36	19198.34	704	22968.19	27335.84	1366	-1198.82	-1.04	0.30
Number of people in the household	4.12	0.98	708	4.25	1.01	1378	-0.13	-2.70	0.01
Number of children in the household	2.27	0.83	708	2.29	0.77	1378	-0.03	-0.80	0.42
Number of parents born abroad	0.28	0.64	708	0.18	0.50	1378	0.10	4.08	0.00
Generation of immigrant child	0.34	0.73	708	0.24	0.63	1378	0.10	3.38	0.00
Birth year mother	1969.42	4.40	708	1969.35	3.87	1378	0.07	0.36	0.72
Birth year father	1966.63	4.92	698	1966.90	4.54	1364	-0.28	-1.27	0.20
Full Time Equivalent mother (0 if no job)	0.36	0.34	708	0.40	0.33	1378	-0.04	-2.36	0.02
Full Time Equivalent father (0 if no job)	0.60	0.47	708	0.65	0.46	1378	-0.05	-2.12	0.03
Educational level mother: primary or lower se	0.13	0.33	708	0.09	0.28	1378	0.04	2.98	0.00
Educational level mother: upper secondary or	0.25	0.43	708	0.25	0.43	1378	0.00	-0.16	0.87
Educational level mother: higher education	0.17	0.37	708	0.19	0.39	1378	-0.02	-0.96	0.34
Educational level mother: missing	0.46	0.50	708	0.48	0.50	1378	-0.02	-0.92	0.36
Socio Econ Status child	35890.34	34550.45	708	38625.11	28132.06	1378	-2734.77	-1.94	0.05

Table A3 – Comparison of parents that did and did not fill out the parental questionnaire

Parental Questionnaire	Did not fill out			Filled out					
TOTAL	Average	SD	Obs	Average	SD	Obs	Average dif	T-Stat	P-avlue
Primary school ability test total score	535.56	9.13	1408	538.13	8.29	678	-2.57	-6.21	0.00
Female	0.55	0.50	1408	0.57	0.49	678	-0.02	-0.82	0.41
Birth country (0=NL, 1=other)	0.97	0.16	1408	0.98	0.13	678	-0.01	-1.30	0.19
Age (in full years)	13.04	0.95	1408	12.65	0.95	678	0.39	8.85	0.00
Situation at home (0=both parents at home, 1=parents divorced or one parent deceased)	0.82	0.38	1408	0.88	0.32	678	-0.06	-3.65	0.00
school	1.53	0.50	1408	1.44	0.50	678	0.08	3.56	0.00
Socio Econ Status at neighborhood level	-0.08	0.91	1403	0.00	0.79	678	-0.08	-2.05	0.04
Grade 7	0.30	0.46	1408	0.47	0.50	678	-0.17	-7.57	0.00
Grade 8	0.37	0.48	1408	0.32	0.47	678	0.05	2.17	0.03
Grade 9	0.33	0.47	1408	0.21	0.41	678	0.12	5.62	0.00
Father has a job	0.86	0.34	1408	0.93	0.25	678	-0.07	-4.56	0.00
Mother has a job	0.81	0.40	1408	0.89	0.31	678	-0.08	-4.84	0.00
Household income	204859.13	928233.99	1408	220957.36	538092.04	678	-16098.23	-0.42	0.68
Income father	53022.87	45329.66	1346	52852.77	33683.22	669	170.11	0.09	0.93
Income mother	22184.27	20164.10	1396	23339.67	32525.44	674	-1155.40	-0.99	0.32
Number of people in the household	4.23	1.09	1408	4.15	0.81	678	0.09	1.88	0.06
Number of children in the household	2.32	0.83	1408	2.21	0.70	678	0.11	2.92	0.00
Number of parents born abroad	0.25	0.59	1408	0.14	0.46	678	0.11	4.15	0.00
Generation of immigrant child	0.31	0.71	1408	0.18	0.56	678	0.13	4.32	0.00
Birth year mother	1969.34	4.18	1408	1969.46	3.80	678	-0.12	-0.64	0.52
Birth year father	1966.63	4.78	1387	1967.17	4.42	675	-0.54	-2.47	0.01
Full Time Equivalent mother (0 if no job)	0.37	0.34	1408	0.41	0.32	678	-0.03	-2.07	0.04
Full Time Equivalent father (0 if no job)	0.61	0.47	1408	0.68	0.45	678	-0.08	-3.58	0.00
Educational level mother: primary or lower se	0.11	0.31	1408	0.09	0.28	678	0.02	1.33	0.18
Educational level mother: upper secondary or	0.25	0.43	1408	0.24	0.43	678	0.02	0.76	0.45
Educational level mother: higher education	0.16	0.37	1408	0.21	0.41	678	-0.05	-2.86	0.00
Educational level mother: missing	0.48	0.50	1408	0.46	0.50	678	0.02	0.73	0.46
Socio Econ Status child	36794.34	31918.07	1408	39571.28	27184.85	678	-2776.94	-1.95	0.05

Table A4 – Comparison of treatment and control group based on observable characteristics

Randomisation full sample	Control group			Treatment Group					
TOTAL	Average	SD	Obs	Average	SD	Obs	Average difference	T-Stat	P-avlue
Primary school ability test total score	536.22	9.16	934	536.53	8.77	1152	-0.30	-0.77	0.44
Female	0.56	0.50	934	0.56	0.50	1152	-0.01	-0.25	0.80
Birth country (0=NL, 1=other)	0.97	0.16	934	0.98	0.14	1152	-0.01	-1.04	0.30
Age (in full years)	12.91	0.97	934	12.92	0.96	1152	-0.01	-0.26	0.80
Situation at home (0=both parents at home, 1=parents divorced or one parent deceased)	0.82	0.38	934	0.85	0.35	1152	-0.03	-1.74	0.08
school	1.54	0.50	934	1.47	0.50	1152	0.07	3.35	0.00
Socio Econ Status at neighborhood level	-0.08	0.90	931	-0.04	0.84	1150	-0.04	-0.97	0.33
Grade 7	0.36	0.48	934	0.35	0.48	1152	0.00	0.15	0.88
Grade 8	0.35	0.48	934	0.35	0.48	1152	0.00	-0.05	0.96
Grade 9	0.29	0.45	934	0.29	0.46	1152	0.00	-0.11	0.91
Father has a job	0.89	0.31	934	0.88	0.33	1152	0.01	1.03	0.30
Mother has a job	0.83	0.38	934	0.84	0.37	1152	-0.01	-0.44	0.66
Household income	194017.91	934677.16	934	223123.28	717723.10	1152	-29105.37	-0.80	0.42
Income father	53453.29	44905.68	903	52571.02	39143.47	1112	882.27	0.47	0.64
Income mother	21426.53	17288.77	922	23471.18	29561.52	1148	-2044.65	-1.86	0.06
Number of people in the household	4.16	0.90	934	4.24	1.08	1152	-0.09	-1.98	0.05
Number of children in the household	2.26	0.75	934	2.30	0.81	1152	-0.04	-1.06	0.29
Number of parents born abroad	0.25	0.59	934	0.18	0.52	1152	0.07	2.79	0.01
Generation of immigrant child	0.32	0.71	934	0.23	0.63	1152	0.09	2.94	0.00
Birth year mother	1969.66	4.16	934	1969.14	3.96	1152	0.52	2.90	0.00
Birth year father	1967.02	4.48	923	1966.64	4.82	1139	0.38	1.85	0.06
Full Time Equivalent mother (0 if no job)	0.38	0.33	934	0.39	0.33	1152	-0.01	-0.62	0.53
Full Time Equivalent father (0 if no job)	0.62	0.47	934	0.64	0.46	1152	-0.02	-1.04	0.30
Educational level mother: primary or lower secondary education	0.11	0.32	934	0.09	0.29	1152	0.02	1.68	0.09
Educational level mother: upper secondary or vocational education	0.24	0.43	934	0.25	0.43	1152	-0.01	-0.56	0.58
Educational level mother: higher education	0.17	0.38	934	0.18	0.39	1152	-0.01	-0.63	0.53
Educational level mother: missing	0.47	0.50	934	0.47	0.50	1152	0.00	-0.05	0.96
Socio Econ Status child	36756.05	31560.32	934	38459.73	29570.16	1152	-1703.68	-1.27	0.20

Table A5 – Comparison of parents that did and did not download the app

Download app	Did not download			Downloaded					
TOTAL	Average	SD	Obs	Average	SD	Obs	Average dif	T-Stat	P-avlue
Primary school ability test total score	536.14	8.97	1678	537.41	8.78	408	-1.26	-2.56	0.01
Female	0.57	0.50	1678	0.54	0.50	408	0.03	1.09	0.27
Birth country (0=NL, 1=other)	0.97	0.16	1678	0.99	0.10	408	-0.02	-2.09	0.04
Age (in full years)	12.95	0.97	1678	12.77	0.92	408	0.19	3.49	0.00
Situation at home (0=both parents at home, 1=parents divorced or one parent deceased)	0.84	0.37	1678	0.85	0.36	408	-0.01	-0.35	0.73
school	1.46	0.50	1678	1.67	0.47	408	-0.21	-7.61	0.00
Socio Econ Status at neighborhood level	-0.05	0.86	1673	-0.09	0.90	408	0.04	0.85	0.39
Grade 7	0.34	0.47	1678	0.41	0.49	408	-0.06	-2.46	0.01
Grade 8	0.36	0.48	1678	0.34	0.47	408	0.02	0.57	0.57
Grade 9	0.30	0.46	1678	0.25	0.43	408	0.05	1.98	0.05
Father has a job	0.88	0.32	1678	0.90	0.30	408	-0.02	-1.20	0.23
Mother has a job	0.82	0.38	1678	0.88	0.32	408	-0.06	-3.00	0.00
Household income	214799.66	881472.77	1678	190727.71	508470.54	408	24071.96	0.53	0.60
Income father	52127.59	42861.19	1619	56395.76	37089.72	396	-4268.16	-1.82	0.07
Income mother	22248.10	25611.79	1663	23836.80	21560.64	407	-1588.70	-1.16	0.25
Number of people in the household	4.23	1.05	1678	4.10	0.80	408	0.13	2.30	0.02
Number of children in the household	2.31	0.81	1678	2.17	0.67	408	0.14	3.24	0.00
Number of parents born abroad	0.24	0.59	1678	0.10	0.37	408	0.14	4.69	0.00
Generation of immigrant child	0.30	0.70	1678	0.15	0.52	408	0.15	4.10	0.00
Birth year mother	1969.32	4.11	1678	1969.61	3.85	408	-0.29	-1.29	0.20
Birth year father	1966.71	4.72	1656	1967.22	4.44	406	-0.51	-1.99	0.05
Full Time Equivalent mother (0 if no job)	0.37	0.33	1678	0.44	0.32	408	-0.07	-3.60	0.00
Full Time Equivalent father (0 if no job)	0.61	0.47	1678	0.71	0.43	408	-0.10	-3.87	0.00
Educational level mother: primary or lower se	0.11	0.31	1678	0.08	0.27	408	0.03	1.70	0.09
Educational level mother: upper secondary or	0.25	0.44	1678	0.22	0.42	408	0.03	1.29	0.20
Educational level mother: higher education	0.16	0.37	1678	0.24	0.43	408	-0.08	-3.59	0.00
Educational level mother: missing	0.47	0.50	1678	0.46	0.50	408	0.02	0.60	0.55
Socio Econ Status child	37181.35	31787.07	1678	39817.30	24308.23	408	-2635.95	-1.57	0.12

Table A6 – All regression results without covariates (1st stage, ITT, OLS and 2nd stage) (appendix to Table 5)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.140***	0.164***	0.144***	0.111***	1,018	0.989	6.020***	-5.719***
	(0.011)	(0.019)	(0.019)	(0.019)	(1,162)	(2,090)	(1,850)	(2,053)
Assignment experiment SES 2	0.211***	0.250***	0.144***	0.197***	1,576	1,971	0.315	2,908
	(0.014)	(0.025)	(0.019)	(0.026)	(1,167)	(2,061)	(1,863)	(2,113)
Assignment experiment SES 3	0.227***	0.251***	0.207***	0.218***	-0.847	0.825	0.451	-4.845**
	(0.014)	(0.025)	(0.022)	(0.025)	(1,131)	(2,121)	(1,748)	(1,963)
N	2081	740	733	608	2081	740	733	608
R-squared					0.002	0.022	0.024	0.028
F-statistic	54,35	25,20	18,61	10,44	0.627	3332,00	3542,00	3427,00
	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	12.495***	16.376***	18.500***	-2624,000	7,125	9,869	41.805***	-51.472**
	-2210,000	-3770,000	-3376,000	-4290,000	(8,250)	(12,286)	(12,977)	(21,635)
Dummy app used SES 2	9.495***	10.001***	7.671***	9.901***	6,217	5,981	1,737	14,778
	-1693,000	-2839,000	-2725,000	-3145,000	(5,561)	(8,023)	(10,384)	(12,572)
Dummy app used SES 3	8.138***	7.748***	7.639***	8.253***	-3,382	2,941	2,179	-22.174**
	-1655,000	-2816,000	-2671,000	-3010,000	(5,006)	(8,281)	(8,537)	(10,518)
N	2081	740	733	608	2081	740	733	608
R-squared	0.041	0.070	0.069	0.028	0.014	0.060	-0.004	-0.346
F-statistic	17671,00	11005,00	10702,00	3427,00	0.635	3465,00	3444,00	2475,00

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table A7 – All regression results with logarithm of minutes practices as dependent variable (1st stage, ITT, OLS and 2nd stage) (appendix to Table 5)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.140***	0.164***	0.144***	0.108***	0.038	0.193	0.358***	-0.624***
	(0.011)	(0.019)	(0.019)	(0.019)	(0.091)	(0.139)	(0.138)	(0.193)
Assignment experiment SES 2	0.211***	0.250***	0.178***	0.202***	0.091	0.148	0.036	0.129
	(0.014)	(0.025)	(0.024)	(0.026)	(0.091)	(0.137)	(0.138)	(0.196)
Assignment experiment SES 3	0.227***	0.251***	0.212***	0.230***	-0.058	0.099	0.131	-0.381**
	(0.014)	(0.025)	(0.023)	(0.025)	(0.088)	(0.141)	(0.131)	(0.184)
N	2081,00	740,00	(733,00)	608,00	2081	740	733	608
R-squared					0.114	0.141	0.176	0.106
F-statistic	54,35	25,20	18,61	10,44	10557	5123,00	6578,00	3015,00

	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	0.722***	1.156***	0.872***	-0.020	0.275	1167,000	2.474***	-5.729***
	(0.173)	(0.256)	(0.258)	(0.403)	(0.643)	(0.816)	(0.958)	(-2,125)
Dummy app used SES 2	0.642***	0.608***	0.408**	0.853***	0.436	0.606	0.246	0.675
	(0.132)	(0.190)	(0.206)	(0.293)	(0.429)	(0.529)	(0.777)	(-1,152)
Dummy app used SES 3	0.573***	0.601***	0.390*	0.841***	-0.262	0.403	0.577	-1.619*
	(0.129)	(0.190)	(0.203)	(0.280)	(0.385)	(0.541)	(0.618)	(0.950)
N	2081	740	733	608	2081	740	733	608
R-squared	0.092	0.140	0.188	0.109	0.089	0.098	0.143	-0.314
F-statistic	8027,00	3530,00	7152,00	3121,00	7998	3364,00	6323,00	2050,00

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table A8 – All regression results (1st stage, ITT, OLS and 2nd stage) for boys (appendix to Table 6)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.181***	0.209***	0.160***	0.163***	2.228	2.426	7.547**	-3.280
	(0.018)	(0.031)	(0.030)	(0.034)	(1.810)	(3.205)	(3.007)	(3.123)
Assignment experiment SES 2	0.213***	0.232***	0.153***	0.272***	1.748	4.586	-1.709	1.784
	(0.022)	(0.038)	(0.037)	(0.042)	(1.780)	(3.152)	(2.688)	(3.355)
Assignment experiment SES 3	0.218***	0.209***	0.197***	0.266***	0.242	3.237	1.158	-2.088
	(0.021)	(0.036)	(0.036)	(0.042)	(1.672)	(3.201)	(2.594)	(2.840)
N	914	344	314	256	914	344	314	256
R-squared					0.083	0.167	0.113	0.130
F-statistic	30.69	10.97	5.45	7.47	3.355	2.916	1.685	1.589

	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	13.523***	22.676***	17.171***	-0.401	12.200	11.136	47.583**	-19.263
	(3.145)	(5.195)	(5.517)	(5.657)	(9.735)	(14.383)	(19.117)	(19.082)
Dummy app used SES 2	8.444***	12.675***	1.510	8.035*	8.292	19.970	-10.696	5.735
	(2.522)	(4.174)	(4.066)	(4.790)	(8.121)	(12.717)	(17.919)	(12.320)
Dummy app used SES 3	7.503***	11.597***	4.336	6.929*	1.035	16.187	5.328	-7.863
	(2.455)	(4.464)	(4.032)	(4.045)	(7.449)	(14.337)	(13.411)	(10.634)
N	914	344	314	256	914	344	314	256
R-squared	0.076	0.143	0.125	0.145	0.046	0.088	0.007	0.054
F-statistic	1.846	1.495	1.884	1.789	1.788	1.406	1.506	1.461

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table A9 – All regression results (1st stage, ITT, OLS and 2nd stage) for girls (appendix to Table 6)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.114***	0.126***	0.139***	0.079***	0.217	-1.100	5.328**	-7.831***
	(0.014)	(0.024)	(0.025)	(0.023)	(1.528)	(2.809)	(2.334)	(2.896)
Assignment experiment SES 2	0.209***	0.258***	0.203***	0.161***	1.443	-0.368	2.541	3.224
	(0.019)	(0.033)	(0.032)	(0.035)	(1.557)	(2.749)	(2.505)	(2.840)
Assignment experiment SES 3	0.238***	0.293***	0.231***	0.194***	-1.923	-1.218	1.271	-6.145**
	(0.019)	(0.037)	(0.030)	(0.032)	(1.544)	(2.859)	(2.355)	(2.838)
N	1167	396	419	352	1167	396	419	352
R-squared					0.072	0.116	0.128	0.068
F-statistic	23.03	9.09	9.89	4.08	3.685	2.217	2.644	1.089
	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	9.866***	10.578*	19.559***	-8.386	2.026	-8.744	38.991**	-95.618**
	(3.157)	(5.767)	(4.333)	(6.947)	(13.381)	(22.042)	(16.372)	(46.821)
Dummy app used SES 2	8.887***	6.624*	8.767**	10.650**	6.981	-1.461	14.244	19.658
	(2.284)	(3.940)	(3.620)	(4.311)	(7.439)	(10.530)	(12.003)	(22.614)
Dummy app used SES 3	7.264***	5.081	7.257**	9.724**	-8.168	-4.243	5.889	-32.738*
	(2.244)	(3.701)	(3.543)	(4.670)	(6.491)	(9.646)	(9.927)	(18.722)
N	1167	396	419	352	1167	396	419	352
R-squared	0.028	0.064	0.176	0.064	0.046	0.097	0.129	-0.634
F-statistic	2.237	1.764	3.852	1.014	2.278	1.829	2.648	0.621

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table A10 – All regression results (1st stage, ITT, OLS and 2nd stage) for mathematics (appendix to Table 7)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.149***	0.189***	0.162***	0.091***	1.472	0.560	4.788**	0.621
	(0.012)	(0.020)	(0.021)	(0.018)	(1.030)	(1.373)	(1.981)	(1.604)
Assignment experiment SES 2	0.217***	0.259***	0.184***	0.204***	1.855*	0.385	5.498***	-1.311
	(0.015)	(0.026)	(0.025)	(0.028)	(1.000)	(1.300)	(1.927)	(1.581)
Assignment experiment SES 3	0.227***	0.237***	0.213***	0.244***	0.150	0.148	0.139	1.793
	(0.015)	(0.026)	(0.024)	(0.027)	(0.962)	(1.332)	(1.816)	(1.468)
N	1920	678	677	565	1920	678	677	565
R-squared					0.906	0.425	0.531	0.574
F-statistic	55.07	27.05	17.32	8.18	701.936	20.106	30.772	30.305
	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	2.170	1.817	4.974	1.251	9.925	2.977	29.713**	6.042
	(1.954)	(2.474)	(3.557)	(3.656)	(6.963)	(7.140)	(13.615)	(17.322)
Dummy app used SES 2	-1.456	0.463	-1.481	-4.037*	8.594*	1.563	30.264***	-6.472
	(1.452)	(1.812)	(2.874)	(2.347)	(4.661)	(4.938)	(11.640)	(7.666)
Dummy app used SES 3	1.790	3.129*	0.961	0.953	0.513	0.650	-0.096	7.445
	(1.428)	(1.873)	(2.832)	(2.200)	(4.290)	(5.516)	(9.459)	(5.942)
N	1920	678	677	565	1920	678	677	565
R-squared	0.906	0.428	0.523	0.575	0.903	0.426	0.398	0.566
F-statistic	701.244	20.332	29.760	30.399	678.403	20.130	23.984	29.720

Controls = pretest, primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table A11 – All regression results (1st stage, ITT, OLS and 2nd stage) for language (appendix to Table 7)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.151***	0.174***	0.167***	0.115***	-2.473	3.627*	-2.070	-6.147**
	(0.012)	(0.021)	(0.022)	(0.021)	(1.910)	(2.122)	(3.685)	(2.482)
Assignment experiment SES 2	0.205***	0.237***	0.188***	0.183***	-0.139	-0.339	1.619	1.761
	(0.016)	(0.028)	(0.028)	(0.028)	(1.859)	(1.944)	(3.667)	(2.481)
Assignment experiment SES 3	0.224***	0.196***	0.248***	0.242***	-0.783	-2.355	0.517	3.003
	(0.015)	(0.026)	(0.026)	(0.028)	(1.756)	(1.958)	(3.407)	(2.232)
N	1709	599	596	514	1709	599	596	514
R-squared					0.676	0.575	0.561	0.856
F-statistic	49.29	18.63	14.79	9.69	134.674	32.394	30.438	121.186
	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	0.785	-2.213	5.314	1.830	-16.349	21.300*	-12.389	-54.861**
	(3.604)	(3.927)	(6.595)	(5.187)	(12.660)	(12.486)	(21.758)	(24.071)
Dummy app used SES 2	1.788	3.832	-0.857	-2.681	-0.768	-0.700	8.367	7.840
	(2.706)	(2.776)	(5.227)	(3.817)	(9.067)	(8.437)	(19.222)	(15.136)
Dummy app used SES 3	-1.832	-0.962	-0.976	3.048	-3.529	-11.630	2.254	13.017
	(2.654)	(2.996)	(5.156)	(3.339)	(7.852)	(10.214)	(13.579)	(10.271)
N	1709	599	596	514	1709	599	596	514
R-squared	0.675	0.574	0.561	0.854	0.671	0.536	0.553	0.813
F-statistic	134.566	32.193	30.455	119.179	132.723	29.623	29.883	93.274

Controls = pretest, primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table A12 – All regression results (1st stage, ITT, OLS and 2nd stage) for mathematics for girls (appendix to Table 7)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.120***	0.137***	0.155***	0.070***	-0.241	0.573	2.177	-1.073
	(0.015)	(0.025)	(0.028)	(0.022)	(1.325)	(1.927)	(2.507)	(2.042)
Assignment experiment SES 2	0.213***	0.264***	0.200***	0.171***	1.500	1.098	3.259	0.311
	(0.020)	(0.035)	(0.033)	(0.037)	(1.299)	(1.826)	(2.566)	(1.916)
Assignment experiment SES 3	0.239***	0.293***	0.227***	0.204***	0.133	0.722	-1.463	1.813
	(0.020)	(0.039)	(0.032)	(0.034)	(1.290)	(1.897)	(2.428)	(1.934)
N	1078	362	387	329	1078	362	387	329
R-squared					0.908	0.431	0.525	0.555
F-statistic	22.76	9.18	9.39	3.20	413.866	11.118	17.409	16.549

	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	2.123	1.449	5.635	0.842	-1.821	4.093	14.960	-16.970
	(2.716)	(3.952)	(4.489)	(5.137)	(10.966)	(13.498)	(16.287)	(29.477)
Dummy app used SES 2	-0.563	4.224	2.157	-7.548***	7.054	4.231	17.037	2.423
	(1.922)	(2.615)	(3.866)	(2.825)	(6.091)	(6.655)	(12.877)	(11.184)
Dummy app used SES 3	2.305	4.308*	0.441	2.643	0.365	2.383	-7.077	9.286
	(1.881)	(2.425)	(3.761)	(3.072)	(5.380)	(6.215)	(10.768)	(9.515)
N	1078	362	387	329	1078	362	387	329
R-squared	0.908	0.440	0.523	0.565	0.906	0.438	0.493	0.524
F-statistic	414.219	11.524	17.335	17.217	406.820	11.257	16.331	15.450

Controls = pretest, primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table A13 – All regression results (1st stage, ITT, OLS and 2nd stage) for mathematic for boys (appendix to Table 7)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.194***	0.242***	0.176***	0.143***	3.606**	0.903	8.203**	1.503
	(0.019)	(0.034)	(0.033)	(0.033)	(1.658)	(2.028)	(3.321)	(2.699)
Assignment experiment SES 2	0.221***	0.245***	0.165***	0.258***	1.922	-0.010	8.477***	-4.419
	(0.024)	(0.041)	(0.041)	(0.044)	(1.586)	(1.899)	(2.989)	(2.841)
Assignment experiment SES 3	0.216***	0.182***	0.207***	0.281***	0.196	0.617	2.812	1.574
	(0.022)	(0.036)	(0.039)	(0.045)	(1.467)	(1.919)	(2.820)	(2.358)
N	842	316	290	236	842	316	290	236
R-squared					0.906	0.458	0.571	0.626
F-statistic	29.12	8.73	5.28	6.25	313.830	10.734	15.410	15.437

	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	2.240	2.408	2.832	0.863	18.531**	3.639	42.330*	9.129
	(2.875)	(3.222)	(5.988)	(5.434)	(8.751)	(8.047)	(25.028)	(19.092)
Dummy app used SES 2	-2.619	-2.938	-5.563	1.284	8.898	0.143	51.529**	-17.086
	(2.238)	(2.566)	(4.419)	(4.135)	(7.324)	(7.459)	(24.070)	(11.169)
Dummy app used SES 3	0.926	1.414	1.762	-0.790	1.016	3.645	14.158	5.923
	(2.225)	(3.015)	(4.363)	(3.332)	(6.932)	(10.123)	(18.045)	(8.472)
N	842	316	290	236	842	316	290	236
R-squared	0.905	0.461	0.551	0.621	0.899	0.458	0.178	0.574
F-statistic	312.121	10.877	14.165	15.096	291.584	10.721	8.041	13.544

Controls = pretest, primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table A14 – All regression results (1st stage, ITT, OLS and 2nd stage) for language for girls (appendix to Table 7)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.131***	0.137***	0.181***	0.084***	-3.500	0.588	-1.205	-4.626
	(0.016)	(0.027)	(0.031)	(0.025)	(2.500)	(2.912)	(4.814)	(3.375)
Assignment experiment SES 2	0.188***	0.219***	0.202***	0.127***	-0.649	-1.031	4.649	2.279
	(0.021)	(0.035)	(0.038)	(0.037)	(2.460)	(2.641)	(5.072)	(3.207)
Assignment experiment SES 3	0.236***	0.265***	0.263***	0.197***	0.485	-2.840	-0.557	5.177*
	(0.021)	(0.039)	(0.035)	(0.036)	(2.369)	(2.660)	(4.665)	(3.105)
N	956	324	342	290	956	324	342	290
R-squared					0.679	0.587	0.540	0.854
F-statistic	22.22	8.36	9.11	3.31	78.672	18.515	16.224	67.668

	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	1.429	1.129	7.265	7.289	-26.742	4.473	-5.823	-57.681
	(4.927)	(5.907)	(8.173)	(8.047)	(19.159)	(20.824)	(26.038)	(46.194)
Dummy app used SES 2	3.753	3.754	5.453	-1.695	-3.530	-4.944	22.750	16.697
	(3.729)	(4.058)	(7.244)	(5.172)	(13.189)	(11.847)	(24.631)	(28.743)
Dummy app used SES 3	-1.153	-0.345	2.791	3.330	1.910	-10.316	-2.993	28.267
	(3.507)	(3.671)	(6.883)	(5.015)	(10.106)	(9.869)	(17.338)	(18.183)
N	956	324	342	290	956	324	342	290
R-squared	0.679	0.586	0.541	0.852	0.666	0.569	0.528	0.794
F-statistic	78.565	18.469	16.281	66.573	75.578	17.771	15.811	47.930

Controls = pretest, primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table A15 – All regression results (1st stage, ITT, OLS and 2nd stage) for language for boys (appendix to Table 7)

	First stage				ITT			
	dependent: dummy whether the parents used the app				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Assignment experiment SES 1	0.179***	0.206***	0.147***	0.178***	-1.292	7.060**	-1.759	-6.864*
	(0.020)	(0.035)	(0.032)	(0.037)	(2.989)	(3.273)	(6.046)	(3.770)
Assignment experiment SES 2	0.221***	0.232***	0.177***	0.279***	1.000	2.819	-1.052	-0.691
	(0.026)	(0.045)	(0.045)	(0.046)	(2.884)	(3.031)	(5.507)	(3.993)
Assignment experiment SES 3	0.215***	0.132***	0.251***	0.283***	-1.787	-2.335	1.935	1.509
	(0.023)	(0.035)	(0.040)	(0.046)	(2.639)	(3.019)	(5.180)	(3.252)
N	753	275	254	224	753	275	254	224
R-squared					0.681	0.589	0.618	0.877
F-statistic	24.64	14.88	4.90	7.84	62.154	15.609	16.151	61.803

	OLS				IV/2SLS			
	dependent: Number of times the child used the homework tool				dependent: Number of times the child used the homework tool			
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	-0.187	-6.976	5.966	-5.324	-7.069	34.689**	-11.444	-38.948*
	(5.375)	(5.532)	(11.798)	(6.914)	(16.466)	(17.130)	(39.694)	(21.216)
Dummy app used SES 2	0.229	5.385	-9.956	-4.319	4.457	12.670	-5.220	-4.548
	(3.969)	(4.031)	(7.696)	(5.632)	(12.860)	(14.088)	(29.878)	(14.458)
Dummy app used SES 3	-3.173	-1.125	-5.279	2.485	-8.499	-13.105	7.880	4.655
	(4.095)	(5.366)	(7.917)	(4.580)	(12.124)	(24.646)	(19.847)	(11.547)
N	753	275	254	224	753	275	254	224
R-squared	0.681	0.584	0.621	0.875	0.679	0.476	0.612	0.860
F-statistic	62.135	15.332	16.390	61.067	61.761	12.260	15.927	54.625

Controls = pretest, primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Online Appendix 2

Online appendix to Section 2

The digital homework practice tool ("Mousework")

The purpose of the interactive digital homework tool is to help students practice their math and language skills, while being able to individualize, and give users direct feedback (Bartelet et al., 2016; Muiswerk, 2013). Although the program is mainly being used in the Netherlands, it also has an international version and is used by several international schools both in Europe and other parts of the world. In the Netherlands, around half of the schools use the program ("Mousework") in some way, although only a small share of the schools use the program in the way it is supposed to work best, namely as a homework tool, next to regular classes that include math and language (e.g. mathematics and Dutch classes).

The program is interactive and person specific. Students work at their own level and get those exercises that will help them improve the sub-aspects of math and language they are not knowledgeable in yet, while some exercises are meant to keep up their already gathered knowledge. Students have a certain set of exercises available, covering all domains of math and language, where they choose from when they log in to the system. A pretest determines students' level of different sub-aspects of math and language, which in turn determines the types of exercises they have practice with at home[1]. At regular intervals (supposedly biweekly, but in practice once every three to four weeks), students make a short computer test at school to determine for which exercises their skills are still lacking and for which exercises their knowledge level is good enough for the moment. After every test, the number, type and level of exercises a student can choose from are adjusted to their new skill level. Apart from that, adjustment is also based on performance while practicing in the tool. The individualization

[1] An earlier study shows that only few students do not have a computer at home to practice with (Haelermans & Ghysels, 2017). However, IP address data shows that these students have practiced with the tool at school, where there are computers available for students that do not have one at home.

therefore makes sure the right exercises are selected for the student, but in the end, until the next adjustment, the student decides in which order he practices the exercises, and whether he repeats an exercise or not. If he performs badly at an exercise, but does not choose to repeat it, it will remain in his selection of exercises, even after the adjustment.

The schools use this tool to make sure each student achieves the highest possible level of math and language, given his/her abilities, and maintains the level achieved. They offer all students online access to the tool for use after school hours, at home. The program functions in a highly individualized manner, as it starts with explanation screens (digital instruction), offers feed-back and provides the student with either repetition or new learning modules on the basis of previous performance of the individual student. It works without teacher interventions, but it does offer both teachers and parents an app where they can see the practice/homework behavior of their class/students, in case of the teacher, or of their son/daughter in case of the parents. Teachers can also use a computer to log on to the system to check upon their class, and may even incorporate knowledge of "Mousework" performance in their interaction with the students in class (but anecdotal evidence from chats at the end of the experiment showed that hardly any teacher at the two schools actually used this feature).

Online appendix to Section 3

Descriptive statistics of the final sample

Table B1 shows the descriptive statistics of the final sample of 2086 students[2]. The average score on the primary school ability test is 536. Note that the scores on this test have a theoretical range from 500 to 550. In total, 56 percent of the students is female, and 98 percent is born in the Netherlands. On average, they were about 13 years old on October 1st 2014, which can be explained by the fact that there are more 7th grade students, who are about 12 years old, than

[2] Note that we are not allowed to present minimum and maximum values of each variable, because of the policy on non-disclosure of individual data by Statistics Netherlands.

9th grade students, who are about 14 years old. Almost 85 percent of students have a stable situation at home, with both parents still living at home (opposed to parents having divorced or one parent being deceased), and both schools have about the same number of students participating in the study, shown by the average of 1.5, for schools number 1 and number 2. The Socio-Economic Status (SES)-variable on the neighborhood of the Netherlands Institute for Social Research (SCP) has an average of -0.06, based on 65 different neighborhoods in our sample. Note that this variable was originally constructed to have a mean of 0 and a standard deviation of 1.

Table B1 furthermore shows that 88 percent of fathers has a job, opposed to 83 percent of mothers, where father's income is much higher than mother's income, with a much larger standard deviation. Note that we have some missings on income, while we do not have missings on the SES variable of the individual child, which is due to the fact that some children live with only one of their officially registered parents (who is then used to calculate the SES indicator). Since we can still identify both parents in the data, it is possible that we have missing income data on the other parent. Table B1 shows that mothers are on average younger than fathers, and that mothers on average work less hours than fathers (Full Time Equivalent; FTE). Most mothers have an upper secondary or vocational educational level. Note that fathers' educational level (not reported) has a similar distribution and all the analyses form this paper yield similar results if we include father's education instead of mother's educational level. We have decided to work with mother's educational level because on average mothers spend more time with their children at home (see variables 'has a job' and 'FTE') and are therefore more likely to be more involved in the school work of their children.

Lastly, Table B1 shows the Socio-Economic Status variable of the child, as well as the distribution of children over the three tertiles of SES. We have created three tertiles to perform interaction analysis between the treatment and SES groups. The lowest SES group (tertile 1)

has a mean SES score of 16777, the middle SES group (tertile 2) has a mean of 32879 and the highest SES group (tertile 3) has a mean of 61793.

In the remainder of this section, descriptive statistics are presented both for the full sample of 2086 students as well as for the three SES-groups separately.

Table B1 – Student, parent and family characteristics

	Obs	Average	St. Dev
Primary school ability test total score	2086	536.39	8.94
Female	2086	0.56	0.50
Birth country (0=NL, 1=other)	2086	0.98	0.15
Age (in full years)	2086	12.92	0.96
Situation at home (0=both parents at home, 1=parents divorced or one parent deceased)	2086	0.84	0.37
school	2086	1.50	0.50
Socio Econ Status at neighborhood level	2081	-0.06	0.87
Grade 7	2086	0.35	0.48
Grade 8	2086	0.35	0.48
Grade 9	2086	0.29	0.45
Father has a job	2086	0.88	0.32
Mother has a job	2086	0.83	0.37
Household income	2086	210091.44	821893.54
Income father	2015	52966.40	41815.64
Income mother	2070	22560.47	24870.57
Number of people in the household	2086	4.21	1.00
Number of children in the household	2086	2.28	0.79
Number of parents born abroad	2086	0.22	0.55
Generation of immigrant child	2086	0.27	0.67
Birth year mother	2086	1969.38	4.06
Birth year father	2062	1966.81	4.67
Full Time Equivalent mother (0 if no job)	2086	0.39	0.33
Full Time Equivalent father (0 if no job)	2086	0.63	0.46
Educational level mother: primary or lower secondary education	2086	0.10	0.30
Educational level mother: upper secondary or vocational education	2086	0.25	0.43
Educational level mother: higher education	2086	0.18	0.38
Educational level mother: missing	2086	0.47	0.50
Socio Econ Status child	2086	37696.91	30481.69
Tertile SES 1	2086	0.32	0.47
Tertile SES 2	2086	0.33	0.47
Tertile SES 3 (highest)	2086	0.35	0.48

Descriptive statistics of Parental use of school administrative system

For almost all students, only one parent has a login name to enter the system. A few students, most likely with divorced parents, have two parents to login. In almost all cases there is one parent that logs in a lot, and the other parent only logs in very occasionally. The average of having one or two parents logging in is 1.02. Therefore, we only use the number of logins between September and February for the first parent. Table B2 shows that on average, parents log in 33 times. Note that this also includes parents that have never logged in during the mentioned time period. This number is the highest for 7th grade students, followed by 8th grade students and lastly 9th grade students, and these differences are significant. Note that parents from the lowest SES group log in less, and parents from the highest SES group log in most, but these differences are not significantly different. The second half of Table B2 shows that roughly two out of three parents logged in at least once. Among the latter parents the average number of logins is 48, which is on average more than 2 times per week. This is again done the most by parents of 7th grade students. However, the separate statistics by SES group show that *if* low SES parents use the online student administrative system, they use it on average the most, of all three SES groups. Furthermore, the separate statistics show that in the low SES group parents in 7th grade use the system the most, whereas in the high SES group parents in grade 9 use the system more often.

Table B2 – Parental use of online student registration system (complete experimental period)

	Obs	Average	St. Dev
Number of times parents checked online student registration system	2,086	32.82	73.41
Number of times parents checked online student registration system (grade 7)	740	44.49	80.16
Number of times parents checked online student registration system (grade 8)	736	29.86	66.57
Number of times parents checked online student registration system (grade 9)	610	22.24	70.81
SES 1	Obs	Average	St. Dev
Number of times parents checked online student registration system	676	28.78	71.99
Number of times parents checked online student registration system (grade 7)	243	42.44	85.35
Number of times parents checked online student registration system (grade 8)	253	48.00	78.88
Number of times parents checked online student registration system (grade 9)	244	42.89	76.24
SES 2	Obs	Average	St. Dev
Number of times parents checked online student registration system	686	33.22	67.80
Number of times parents checked online student registration system (grade 7)	234	22.94	55.64
Number of times parents checked online student registration system (grade 8)	241	32.76	72.85
Number of times parents checked online student registration system (grade 9)	261	33.38	69.22
SES 3	Obs	Average	St. Dev
Number of times parents checked online student registration system	724	36.21	79.49
Number of times parents checked online student registration system (grade 7)	199	18.95	68.95
Number of times parents checked online student registration system (grade 8)	192	14.34	30.99
Number of times parents checked online student registration system (grade 9)	219	32.15	93.20

WHEN USED AT ALL

	Obs	Average	St. Dev
Number of times parents checked online student registration system	1,402	48.83	85.07
Number of times parents checked online student registration system (grade 7)	485	67.88	90.66
Number of times parents checked online student registration system (grade 8)	510	43.09	76.34
Number of times parents checked online student registration system (grade 9)	407	33.33	84.57
SES 1	Obs	Average	St. Dev
Number of times parents checked online student registration system	384	50.66	89.57
Number of times parents checked online student registration system (grade 7)	137	75.28	102.33
Number of times parents checked online student registration system (grade 8)	173	70.20	86.88
Number of times parents checked online student registration system (grade 9)	175	59.80	84.27
SES 2	Obs	Average	St. Dev
Number of times parents checked online student registration system	495	46.04	76.04
Number of times parents checked online student registration system (grade 7)	131	40.98	69.31
Number of times parents checked online student registration system (grade 8)	191	41.34	79.67
Number of times parents checked online student registration system (grade 9)	188	46.34	77.84
SES 3	Obs	Average	St. Dev
Number of times parents checked online student registration system	523	50.13	89.74
Number of times parents checked online student registration system (grade 7)	116	32.52	87.98
Number of times parents checked online student registration system (grade 8)	131	21.02	35.64
Number of times parents checked online student registration system (grade 9)	160	44.00	106.70

The number of logins provides interesting reference information for the parental involvement experiment, because it serves as a signal of involvement and more particularly of the willingness of parents to use an electronic instrument to get involved in the education process of their child. All parents were granted access to the learning management system. Two out of three effectively used it and, moreover, tended to do so intensely. Apparently, parents have a high willingness to be in touch with the school work of their children and, especially in 7th grade, check upon progress various times per week.

Descriptive statistics of Mathematics and Language tests

The math test consists of relatively simple multiplication or addition questions, but also contains special understanding questions, where the student sees an unfolded shape and is asked to select the figure that could create the unfolded shape. Or the student is asked to calculate the volume of a sphere, or is asked to quickly make calculations by heart. The math test contains multiple choice questions and students were allowed to use scrap paper for their calculations, but no digital calculator. The math tests lasted for about 20 minutes. The language tests for example consists of spelling questions, vocabulary questions, text comprehension, grammar questions, and having to listen to some information and answer a question about that. The language test lasted for about 90 minutes.

Table B3 describes the average scores for the full experiment population, as well as per grade and SES group, highlighting the learning progress students make over time (all posttest averages are markedly higher than pretest averages for math, with the exception of language

for grade 7 students[3]), but also indicating the large variance of all test results. Note that some students were not present during the pretest or the posttest of mathematics and/or language, due to illness[4].

Table B3 – Math and language tests

	Obs	Average	St. Dev
Score math pretest	2,033	86.96	43.24
Score math posttest	1,953	110.37	40.25
Score math pretest (grade 7)	722	47.98	12.02
Score math posttest (grade 7)	689	60.73	12.70
Score math pretest (grade 8)	717	100.02	39.56
Score math posttest (grade 8)	689	134.91	20.16
Score math pretest (grade 9)	717	100.02	39.56
Score math posttest (grade 9)	575	140.45	15.56
SES 1	Obs	Average	St. Dev
Score math pretest	645	86.18	42.59
Score math posttest	607	106.42	39.94
Score math pretest (grade 7)	233	47.06	12.85
Score math posttest (grade 7)	215	58.24	13.52
Score math pretest (grade 8)	223	98.38	38.38
Score math posttest (grade 8)	211	130.20	21.59
Score math pretest (grade 9)	189	120.04	32.33
Score math posttest (grade 9)	181	135.92	17.23
SES 2	Obs	Average	St. Dev
Score math pretest	674	87.62	43.59
Score math posttest	651	108.99	40.50
Score math pretest (grade 7)	247	47.46	11.52
Score math posttest (grade 7)	241	60.96	12.51
Score math pretest (grade 8)	238	103.74	39.00
Score math posttest (grade 8)	228	134.04	21.31
Score math pretest (grade 9)	189	119.81	34.96
Score math posttest (grade 9)	182	141.21	14.40
SES 3	Obs	Average	St. Dev
Score math pretest	714	87.04	43.53
Score math posttest	695	115.12	39.87
Score math pretest (grade 7)	242	49.41	11.61
Score math posttest (grade 7)	233	62.80	11.72
Score math pretest (grade 8)	256	97.99	40.98

[3] This is due to a test element that was only included in the pretest, on which almost all students scored very high, that was not included in the posttest.

[4] Since the baseline outcome measure of our analysis is whether and how much the student practiced in the online tool, we decided not to limit our sample to the students for whom we have complete test information.

Score math posttest (grade 8)	250	139.67	16.55
Score math pretest (grade 9)	216	116.23	39.37
Score math posttest (grade 9)	212	143.67	14.09

Table B3 – Math and language tests – continued

	Obs	Average	St. Dev
Score language pretest	1,909	168.43	42.46
Score language posttest	1,853	157.22	39.98
Score language pretest (grade 7)	646	179.63	53.27
Score language posttest (grade 7)	680	132.30	27.14
Score language pretest (grade 8)	695	159.49	34.17
Score language posttest (grade 8)	625	162.08	36.37
Score language pretest (grade 9)	695	159.49	34.17
Score language posttest (grade 9)	548	182.60	39.31
SES 1	Obs	Average	St. Dev
Score language pretest	593	158.83	46.54
Score language posttest	580	148.52	39.63
Score language pretest (grade 7)	198	162.69	64.53
Score language posttest (grade 7)	213	125.22	32.25
Score language pretest (grade 8)	214	156.53	36.62
Score language posttest (grade 8)	196	153.86	32.82
Score language pretest (grade 9)	181	157.31	30.90
Score language posttest (grade 9)	171	171.41	39.69
SES 2	Obs	Average	St. Dev
Score language pretest	639	166.66	42.57
Score language posttest	607	155.18	38.98
Score language pretest (grade 7)	228	180.63	52.67
Score language posttest (grade 7)	234	132.35	26.98
Score language pretest (grade 8)	233	154.42	32.21
Score language posttest (grade 8)	202	158.13	33.95
Score language pretest (grade 9)	178	164.80	34.09
Score language posttest (grade 9)	171	182.94	39.41
SES 3	Obs	Average	St. Dev
Score language pretest	hhhh	178.50	36.00
Score language posttest	666	166.67	39.26
Score language pretest (grade 7)	220	193.84	35.67
Score language posttest (grade 7)	233	138.74	19.66
Score language pretest (grade 8)	248	166.81	32.62
Score language posttest (grade 8)	227	172.70	38.87
Score language pretest (grade 9)	209	176.21	34.52
Score language posttest (grade 9)	206	191.62	36.65

Questionnaires

a. Student questionnaire

During our study, students were asked to fill out a questionnaire, with questions on the courses mathematics and Dutch, on the program Mousework, on the time spent on homework, on their opinion on parental involvement and on their work attitude[5]. In the current paper we draw on the questions on homework time and on parental involvement. The questions on homework time were: "How much time do you on average spend on homework for Dutch/Mathematics?" (1 question per subject) The answer options were: 0-15 minutes, 15-30 minutes, 30-45 minutes, 45-60 minutes or more than 60 minutes. The questions on parental involvement were: "I would like to get more help from my parents with my homework", and "I would like my parents to interfere less regarding me and my school work". The answer options were: No absolutely not, mostly not, neutral, sometimes, yes absolutely (5-point Likert scale).

Filling out the questionnaire took 10 to 15 minutes. The questionnaire was distributed on paper to the mentor (coach) of each class, who was asked to have the class fill it out. Unfortunately, not all mentors have handed out the questionnaire, and not all students were present during that time. Therefore, the response rate of the questionnaire is only 66 percent. This number is a little higher for grade 8, and a little below average for grade 9 (see Table B4). The presented separate descriptives per SES group show quite some differences, both between and within the SES groups, which are significantly different both across grade levels and between SES groups.

Additional analyzes (that can be found in Table A2 of Online Appendix 1) show that students that did fill out the questionnaire are on average a bit different from students who did not. Note

[5] The full questionnaire (translated into English) is available upon request from the corresponding author.

that students were not necessarily the ones to decide whether to fill it out, as it was the teacher who decided whether to hand it out or not. However, students are clustered in classes, and this clustering is not random. In comparing the two groups, we see that students that did fill out more often have a higher primary school ability test score, a stable home situation (which might result in students not being present in class when the questionnaire was handed out), a higher SES (and underlying variables), and that more students from school 1 filled out the questionnaire.

Table B4 – Student Questionnaire

	Obs	Average	St. Dev
Filled out student questionnaire	2,086	0.66	0.47
Filled out student questionnaire (grade 7)	740	0.66	0.48
Filled out student questionnaire (grade 8)	736	0.69	0.46
Filled out student questionnaire (grade 9)	610	0.63	0.48
SES 1	Obs	Average	St. Dev
Filled out student questionnaire	676	0.58	0.49
Filled out student questionnaire (grade 7)	243	0.54	0.50
Filled out student questionnaire (grade 8)	253	0.70	0.46
Filled out student questionnaire (grade 9)	244	0.72	0.45
SES 2	Obs	Average	St. Dev
Filled out student questionnaire	686	0.69	0.46
Filled out student questionnaire (grade 7)	234	0.65	0.48
Filled out student questionnaire (grade 8)	241	0.69	0.46
Filled out student questionnaire (grade 9)	261	0.74	0.44
SES 3	Obs	Average	St. Dev
Filled out student questionnaire	724	0.70	0.46
Filled out student questionnaire (grade 7)	199	0.55	0.50
Filled out student questionnaire (grade 8)	192	0.68	0.47
Filled out student questionnaire (grade 9)	219	0.64	0.48

b. Parental questionnaire

During our study, parents were also asked to fill out a questionnaire. The parental questionnaire first of all contained background questions on the parents, for example on their age, ethnicity, labor market situation, and educational level. Furthermore, it contained a few questions on Mousework and the app, and eight statements on parental involvement in general (4-point Likert scale, ranging from 1=never to 4=a lot). In this study, we only use the questions on general parental involvement. The questions were the following: Do you make agreements with your child on homework, do you ask your child about its progress, do you help your child with homework, do you talk with your child about school, does your child need a lot of help, do you help your child when it has motivational problems and do you help your child with the computer?

Filling out the questionnaire would take about 10-15 minutes. The questionnaire was first sent via e-mail via the school administrative system of the schools. As that only generated a low response, the questionnaire was also distributed on paper to the mentor (coach) of each class, who was asked to hand it out to students, who were asked to have their parents fill it out and bring the questionnaire back to school. With the two efforts combined (both digital and on paper), the total response rate was about 33 percent (see Table B5). However, for 7^{th} grade students more than 40 percent of the parents filled out the questionnaire, whereas for 9^{th} grade students this is only 24 percent. The presented separate descriptives per SES group show quite some differences, both between and within the SES groups, which are significantly different both between and within grade level, SES groups and the interaction of those two.

Students of parents who did fill out the questionnaire are very different from students of parents who did not fill it out. As additional analyses show (see Table A3 of Online Appendix 1),

children from parents who did fill out have a higher score on the primary school ability test, are a bit younger (most likely because 7th grade students are overly represented in the group that did fill out the parental questionnaire) and have more often a stable home situation and a higher SES (and underlying variables).

Table B5 – Parental Questionnaire

	Obs	Average	St. Dev
Filled out parental questionnaire	2,086	0.33	0.47
Filled out parental questionnaire (grade 7)	740	0.43	0.50
Filled out parental questionnaire (grade 8)	736	0.29	0.46
Filled out parental questionnaire (grade 9)	610	0.24	0.43
SES 1	Obs	Average	St. Dev
Filled out parental questionnaire	676	0.28	0.45
Filled out parental questionnaire (grade 7)	243	0.32	0.47
Filled out parental questionnaire (grade 8)	253	0.47	0.50
Filled out parental questionnaire (grade 9)	244	0.50	0.50
SES 2	Obs	Average	St. Dev
Filled out parental questionnaire	686	0.34	0.47
Filled out parental questionnaire (grade 7)	234	0.26	0.44
Filled out parental questionnaire (grade 8)	241	0.30	0.46
Filled out parental questionnaire (grade 9)	261	0.32	0.47
SES 3	Obs	Average	St. Dev
Filled out parental questionnaire	724	0.35	0.48
Filled out parental questionnaire (grade 7)	199	0.25	0.43
Filled out parental questionnaire (grade 8)	192	0.22	0.42
Filled out parental questionnaire (grade 9)	219	0.23	0.42

Online Appendix 3

Mechanisms – Differential results by grade level

In order to get an idea about the mechanisms behind the effects that we found above in Section 5, we ran correlations between the answers of students in the student questionnaire, about the (desired level of) parental involvement, and the answers of parents in the parental questionnaire, about their involvement. Table C1 shows these correlations (and their statistical significance). Note that we only include two questions from the student questionnaire, which are the same questions that were also included in the regression analysis that we used in the robustness check, namely whether the student would like more help from the parent with homework, and whether the student feels that the parent should interfere less. A third student indicator is the number of minutes the students has worked in the homework tool. Note that this indicator appears twice in the correlation table, both as the first variable in the vertical list and the third variable in the horizontal listing of variables, as the results show that this is also related to the two questions from the student questionnaire. As for the parental questionnaire, we included all questions on parental involvement that are present in the questionnaire. The results are presented for the total sample, but also for the three grades separately. This is done as we also found very different results for the different grades in the previous two sections, and different results on the correlations might help explain or confirm the earlier findings.

As for the first student question, Table C1 first of all shows that overall, students who would like more help from their parents, also have parents that ask significantly less about progress at school (indicating that they would like more formal involvement than they are receiving at the moment). The results are mostly driven by 8^{th} grade students.

Overall parents of students that would like more help, do indicate that they talk to their child about school less often (or, vice versa parents that talk to their children about school more often have children that indicate that they want less help), but do more often help the child with the computer, both of which seem to be driven by 9th grade students. Lastly, the parents of students that indicate they would like more help, also indicate that they feel their child needs more help. For the individual grades, this is found for all three grade levels.

As for the second student question, students who feel their parents should interfere less, spend significantly less time in the homework tool, and have parents that indicate that they do not talk much with the child about school, or help their child with homework. That students practice less in the tool is mainly driven by 9th grade students. The finding that students who want their parents to interfere less have parents that also talk less with the child about school is driven by 8th grade students, whereas the finding that parents feel that the student needs (much) help, while the students feel that their parents should interfere less is found for 7thgrade students.

As for the number of minutes spent in the practice tool, this is positively related to the number of times the parents have used the app (found for all three grades), is positively related to the way parents feel about whether their child needs little help for 9th grades students (if parents feel less help is needed, students practice more) and is negatively related to whether the parent helps the child when the motivation is gone, implying that if the parents try to help the child without motivation, the child practices less in the homework tool. The latter two findings are only significant for 9th grade students.

Table C1 – Correlations parental involvement questions student and parental questionnaires (total N=571)

	Total			grade 7			grade 8			grade 9		
	I would like more homework help from parents	Parents should interfere less	Number of minutes in homework tool by child	I would like more homework help from parents	Parents should interfere less	Number of minutes in homework tool by child	I would like more homework help from parents	Parents should interfere less	Number of minutes in homework tool by child	I would like more homework help from parents	Parents should interfere less	Number of minutes in homework tool by child
Number of minutes in homework tool	0.05	-0.06	1	0.10	0.02	1	-0.04	-0.04	1	0.01	-0.15	1
	(0.09)	(0.03)		(0.03)	(0.70)		(0.42)	(0.32)		(0.90)	(0.00)	
Number of times app checked	0.00	0.03	0.19	-0.06	0.02	0.20	0.05	0.02	0.29	0.00	0.04	0.12
	(0.94)	(0.33)	(0.00)	(0.20)	(0.60)	(0.00)	(0.29)	(0.62)	(0.00)	(0.93)	(0.47)	(0.00)
Do you have agreements on homework with child	-0.07	0.02	-0.01	-0.13	-0.06	-0.03	-0.10	0.13	0.08	0.14	-0.12	-0.01
	(0.12)	(0.70)	(0.82)	(0.05)	(0.39)	(0.55)	(0.19)	(0.09)	(0.27)	(0.16)	(0.23)	(0.91)
Do you ask child about progress	-0.13	-0.04	0.00	-0.09	-0.14	0.04	-0.15	-0.01	0.09	-0.12	0.01	-0.08
	(0.00)	(0.35)	(0.90)	(0.17)	(0.04)	(0.52)	(0.05)	(0.89)	(0.21)	(0.23)	(0.92)	(0.32)
Do you talk to child about school	0.02	-0.13	0.05	-0.05	-0.08	0.08	0.07	-0.26	0.09	0.07	-0.01	-0.09
	(0.62)	(0.00)	(0.21)	(0.50)	(0.21)	(0.18)	(0.39)	(0.00)	(0.21)	(0.45)	(0.96)	(0.29)
Does child need little help	-0.12	-0.13	0.06	-0.12	-0.18	0.04	-0.05	-0.08	0.06	-0.18	-0.14	0.21
	(0.01)	(0.00)	(0.11)	(0.09)	(0.01)	(0.53)	(0.51)	(0.30)	(0.41)	(0.06)	(0.15)	(0.01)
Do you help child with homework	0.19	0.02	-0.04	0.18	0.06	0.01	0.17	0.05	-0.08	0.17	-0.08	-0.20
	(0.00)	(0.70)	(0.31)	(0.01)	(0.41)	(0.82)	(0.03)	(0.56)	(0.25)	(0.08)	(0.40)	(0.02)
Do you help child if motivation is gone	0.05	-0.01	-0.07	0.01	-0.04	-0.05	0.11	0.01	-0.07	-0.06	0.09	-0.20
	(0.32)	(0.86)	(0.08)	(0.94)	(0.53)	(0.37)	(0.15)	(0.95)	(0.32)	(0.57)	(0.38)	(0.02)
Do you help child with computer	0.12	-0.01	-0.01	0.07	0.00	-0.03	0.08	-0.02	0.04	0.24	0.01	-0.12
	(0.01)	(0.77)	(0.84)	(0.28)	(0.98)	(0.57)	(0.32)	(0.82)	(0.53)	(0.01)	(0.96)	(0.17)
P-values in parentheses												

Mechanisms – Differential results by SES

Table C2 – Potential mechanisms differential results by SES – minutes practices per week by grade level and SES-group

	SES1			SES2			SES3		
	Obs	Average	St. Dev	Obs	Average	St. Dev	Obs	Average	St. Dev
Minutes practiced per week - grade 7 (NO app)	224	11.87	13.69	217	17.30	17.20	207	15.87	14.96
Minutes practiced per week - grade 7 (app used)	19	28.25	20.90	36	27.30	20.04	37	23.62	15.77
Minutes practiced per week - grade 8 (NO app)	216	13.32	14.23	213	10.32	11.68	232	11.60	12.45
Minutes practiced per week - grade 8 (app used)	18	31.78	25.69	28	18.70	17.91	29	20.01	18.10
Minutes practiced per week - grade 9 (NO app)	187	12.65	16.26	169	9.88	12.42	193	11.74	13.99
Minutes practiced per week - grade 9 (app used)	12	10.02	10.87	29	20.01	18.10	26	20.05	14.96

Table C3 – Potential mechanisms differential results by SES – student and parental questionnaire answers by SES-group

	SES1			SES2			SES3			
	Obs	Average	St. Dev	Obs	Average	St. Dev	Obs	Average	St. Dev	P-value of difference?
Student Questionnaire										
Do you help child with homework	187	2.11	0.57	234	2.12	0.55	254	2.14	0.59	0.89
Do you help child if motivation is gone	184	2.65	0.77	226	2.55	0.67	244	2.65	0.77	0.26
Do you help child with computer	188	1.77	0.63	232	1.88	0.55	253	1.76	0.57	0.04
Do you have agreements on homework with child	188	1.61	1.25	234	1.54	1.12	254	1.59	1.15	0.81
Do you ask child about progress	187	2.47	1.87	233	2.33	1.73	252	2.48	1.82	0.59
Do you talk to child about school	188	2.96	0.67	232	2.98	0.61	254	3.06	0.61	0.22
Does child need little help	184	2.65	0.75	226	2.75	0.78	248	2.89	0.78	0.00
Do you or your partner have asmartphone or tablet?	187	0.90	0.30	232	0.97	0.18	255	0.96	0.18	0.01
Did you download and install the app?	184	0.33	0.47	229	0.37	0.48	255	0.36	0.48	0.67
Did you use the app	152	0.17	0.38	180	0.22	0.42	199	0.20	0.40	0.50
How often did you use the app?	96	4.35	1.23	116	4.07	1.42	129	4.12	1.36	0.26
Are you satisfied with the app?	155	0.18	0.39	177	0.17	0.38	192	0.19	0.39	0.90
Number of times parents checked the app	676	1.26	7.66	686	2.81	16.18	724	2.09	9.47	0.05
Parental Questionnaire										
I have computer at home to practice my homework	394	3.63	0.88	472	3.72	0.76	508	3.69	0.80	0.28
Practicing exercises of Mousework online works well	394	2.78	1.01	473	2.73	1.01	504	2.79	1.01	0.64
I often cannot practice because there a no new exercises available or me	394	1.93	1.04	471	1.88	1.03	502	1.75	0.94	0.02
I like the fact that Mousework gives explanation right away when i answer a question wrong	390	2.57	1.11	472	2.64	1.04	498	2.56	1.05	0.45
If I want to use Mousework at home, there are often problems with the website	391	2.12	1.09	472	2.08	1.04	502	2.07	1.05	0.77
If I use Mousework online, I simultaneously use Facebook, Twitter or other social media website	393	2.39	1.25	473	2.37	1.22	502	2.38	1.16	0.98
I'd like more help from my parents with my homework	390	2.01	1.09	473	2.01	1.08	505	1.87	1.01	0.06
I'd like less interference by my parents in school related issues	391	2.44	1.24	472	2.69	1.32	505	2.54	1.24	0.01
Minutes per week practiced	676	13.51	15.68	686	13.99	15.42	724	14.11	14.48	0.73

Table C4 – Potential mechanisms differential results by SES – correlations between whether parent downloaded the app and answers to parental questionnaire, by SES-group

Correlations	Total	SES1	SES2	SES3
	Downloaded the app			
Filled out parental questionnaire	0.11	0.11	0.10	0.11
	(0.00)	(0.00)	(0.00)	(0.00)
Do you have agreements on homework with child	0.02	-0.03	-0.01	0.09
	(0.57)	(0.61)	(0.84)	(0.11)
Do you ask child about progress	-0.03	0.00	-0.06	-0.03
	(0.34)	(0.96)	(0.31)	(0.55)
Does child need little help	0.01	0.11	-0.03	-0.01
	(0.66)	(0.13)	(0.60)	(0.92)
Do you talk to child about school	0.01	0.14	-0.07	-0.02
	(0.89)	(0.05)	(0.23)	(0.64)
Do you help child with homework	0.02	0.10	-0.01	-0.02
	(0.65)	(0.15)	(0.83)	(0.73)
Do you help child if motivation is gone	0.05	0.10	0.03	0.03
	(0.17)	(0.16)	(0.58)	(0.58)
Do you help child with computer	0.03	0.12	-0.05	0.02
	(0.43)	(0.09)	(0.48)	(0.73)
Number of times logged in to school admin system	0.08	0.16	0.14	-0.30
	(0.00)	(0.00)	(0.00)	(0.36)

P-values in parentheses

Correlations	Total	SES1	SES2	SES3
Correlation school admin system used and app used	0.09	0.11	0.05	0.07
	(0.00)	(0.00)	(0.12)	(0.06)
Correlation number of times logged in to school admin system and number of times app used	0.05	0.05	0.08	0.02
	(0.01)	(0.18)	(0.03)	(0.48)

P-values in parentheses

Table C5 – Potential mechanisms differential results by SES – Cross tabs on app statistics by SES-group

Cross tabs	SES1	SES2	SES3	P-value of chi-squared
	676	686	724	
	32.41%	32.89%	34.71%	
Control group app	327	286	321	
	35.01%	30.62%	34.37%	
Treatment group app	349	400	403	
	30.30%	34.72%	34.98%	0.04
Did not fill out student questionnaire	282	210	216	
	39.83%	29.66%	30.51%	
Filled out student questionnaire	394	476	508	
	28.59%	34.54%	36.87%	0.00
Did not fill our parental questionnaire	487	452	469	
	24.59%	32.10%	33.31%	
Filled out parental questionnaire	189	234	255	
	27.88%	34.51%	37.61%	0.01
Did not use parental app	627	597	631	
	33.80%	32.18%	34.02%	
Used parental app	49	87	92	
	21.21%	38.16%	40.35%	0.00
Did not download app	565	539	574	
	33.67%	32.12%	34.21%	
Downloaded app	111	147	150	
	27.21%	36.03%	36.76%	0.04
Did not use parental app (if downloaded)	62	60	58	
	35.03%	33.33%	32.22%	
Used parental app (if downloaded)	49	87	93	
	21.21%	38.16%	40.35%	0.008

	SES1	SES2	SES3	p-value of ANOVA
Number of times parents logged in to school admin system (mean)	28.78	33.22	36.21	0.16
Number of minutes per week the student practiced (mean)	13.50	13.99	14.11	0.73

Table C6 – Potential mechanisms differential results by SES – Cross tabs on app statistics by SES-group

Correlations	SES1	SES2	SES3
	Parents used app		
Younger child vs. Oldest child	-0.07	-0.12	-0.10
	(0.06)	(0.00)	(0.00)

	SES1	SES2	SES3	p-value of ANOVA
Younger child: I'd like less interference by my parents in school related issues	2.46	2.62	2.50	0.36
Oldest child: I'd like less interference by my parents in school related issues	2.43	2.74	2.60	0.03
Birth Year Mother	1970	1969	1969	0
Birth Year Father	1967	1966	1966	0.01

Correlations		
Within tertile SES 1	App used	App downloaded
Socio Economic Status	0.06	0.08
	(0.08)	(0.03)
Educational level mother	0.03	-0.02
	(0.32)	(0.61)

Table C7 – Regression separately for younger and oldest children

	Younger child				Oldest child			
	ITT ; dependent: Number of times the child used the homework tool							
	Total	Grade 7	Grade 8	Grade 9	Total	Grade 7	Grade 8	Grade 9
Dummy app used SES 1	1.659	1.497	7.310***	-4.791*	1.581	3.104	6.733**	-7.338**
	(1.353)	(2.246)	(2.210)	(2.611)	(1.793)	(3.196)	(2.778)	(3.439)
Dummy app used SES 2	2.383*	4.636*	-0.568	3.714	1.112	1.579	0.026	0.917
	(1.443)	(2.554)	(2.303)	(2.612)	(1.792)	(2.999)	(2.775)	(3.609)
Dummy app used SES 3	-0.507	3.166	1.398	-4.193*	-0.708	1.416	1.059	-5.826*
	(1.385)	(2.606)	(2.203)	(2.466)	(1.705)	(2.985)	(2.632)	(3.282)
N	1272	419	466	387	1049	419	346	284
R-squared	0.083	0.173	0.135	0.065	0.079	0.123	0.131	0.077
F-statistic	4.529	3.600	3.002	1.099	3.493	2.416	2.111	0.938

Controls = primary school ability score, gender, age, country of birth, situation at home, ses (neighborhood), mother part time, mother has a job, number of people in the household, educational level mother, individual SES, number of parents born abroad, child born abroad, school, type of education, grade level

standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$